SCIENCE

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*THE DEBT OF THE WORLD TO PURE SCIENCE.**

THE fundamental importance of abstruse research receives too little consideration in our time. The practical side of life is all-absorbent; the results of research are utilized promptly and full recognition is awarded to the one who utilizes while the investigator is ignored. The student himself is liable to be regarded as a relic of medieval times and his unconcern respecting ordinary matters is serviceable to the dramatist and newspaper witlet in their times of need.

Yet every thoughtful man, far away as his calling may be from scientific investigation, hesitates to accept such judgment as accurate. Not a few, engrossed in the strife of the market-place, are convinced that, even from the selfish standpoint of mere enjoyment, less gain is found in amassing fortunes or in acquiring power over one's fellows than in the effort to solve Nature's problems. Men scoff at philosophical dreamers, but the scoffing is not according to knowledge. The exigencies of subjective philosphy brought about the objective philosophy. Error has led to the right. Alchemy prepared the way for Chemistry; Astrology for Astronomy; Cosmogony for Geology. The birth of in-

* Presidential address delivered at the annual meeting of the New York Academy of Sciences, February 28, 1898.

ductive science was due to the necessities of deductive science, and the greatest development of the former has come from the trial of hypotheses belonging in the borderland between science and philosophy.

My effort this evening is to show that discoveries, which have proved all-important in secondary results, did not burst forth full-grown; that in each case they were, so to say, the crown of a structure reared painfully and noiselessly by men indifferent to this world's affairs, caring little for fame and even less for wealth. Facts were gathered, principles were discovered, each falling into its own place until at last the brilliant crown shone out and the world thought it saw a miracle.

This done, I shall endeavor to draw a moral, which it is hoped will be found worthy of consideration.

The heavenly bodies were objects of adoration from the earliest antiquity; they were guides to caravans on the desert as well as to mariners far from land; they marked the beginning of seasons or, as in Egypt, the limits of vast periods embracing many hundreds of years. Maps were made thousands of years ago showing their positions; the path of the sun was determined rudely; the influence of the sun and moon upon the earth was recognized in some degree and their influence upon man was inferred. Beyond these matters, man, with unaided vision and with knowledge of only elementary mathematics, could not go.

Mathematical investigations by Arabian students prepared the means by which, after Europe's revival of learning, one, without wealth, gave a new life to astronomy. Copernicus, early trained in mathematics, during the last thirty years of his life spent the hours, stolen from his work as a clerk and charity physician, in mathematical and astronomical studies, which led him to reject the complex Ptolemaic system and to accept, in modified form, that bearing the name of Pythagoras. Tycho Brahe followed. A mere star-gazer at first, he became an earnest student, improved the instruments employed, and finally secured recognition from his sovereign. For twenty-five years he sought facts, disregarding none, but seldom recognizing economic importance in any. His associate, Kepler, profiting by his training under Brahe, carried the work far beyond that of his predecessors—and this in spite of disease, domestic sorrows and only too frequent experience of abject poverty. He divested the Copernican hypothesis of many crudities and discovered the laws which have been utilized by astronomers in all phases of their work. He ascertained the causes of the tides, with the aid of the newly invented telescope made studies of eclipses and occultations and just missed discovering the law of gravitation. He laid the foundation for practical application of astronomy to every-day life.

In the 18th century astronomy was recognized by governments as no longer of merely curious interest and its students received abundant aid. The improvement of the telescope, the discovery of the law of gravitation and the invention of logarithms had made possible the notable advances marking the close of the 17th century. The increasing requirements of accuracy led to exactness in the manufacture of instruments, to calculation and recalculation of tables, to long expeditions for testing methods as well as conclusions, until finally the suggestion of Copernicus, the physician, and of Kepler, the ill-fed invalid, became fact, and astronomical results were utilized to the advantage of mankind. The voyager on the ocean and the agriculturist on land alike reap benefit from the accumulated observations of three centuries, though they know nothing of the principles or of the laborers by whom the principles were discovered. The regulation of chronom-

eters as well as the fixing of boundary lines between great nations is determined by methods due to slow accumulation of facts, slower development in analysis and calculation and even slower improvement in instruments.

Galvani's observations that frogs' legs twitch when near a friction machine in operation led him to test the effect of atmospheric electricity upon them. The instant action brought about the discovery that it was due not to atmospheric influence, but to a current produced by contact of a copper hook with an iron rail. Volta pursued the investigation and constructed the pile which bears his name. With this, modified, Davy, in 1807, decomposed potash and soda, thereby isolating potassium and sodium. This experiment, repeated successfully by other chemists, was the precursor of many independent investigations, which directed to many lines of research, each increasing in interest as it was followed.

Volta's crown of cups expanded into the clumsy trough batteries which were displaced finally in 1836 by Daniel's constant battery, using two fluids, one of which was cupric sulphate. De la Rue observed that, as the sulphate was reduced, the copper was deposited on the surface of the outer vessel and copied accurately all markings on that surface. Within two or three years Jacobi and Spencer made the practical application of this observation by reproducing engravings and medals. Thus was born the science of electro-metallurgy. At first mere curiosities were made, then electro-plating in a wider way, the electrotype, the utilization of copper to protect more easily destructible metals, the preparation of articles for ornament and utility by covering baser metals with copper or silver or gold, while now the development of electro-generators has led to wide applications in the reduction of metals and to the saving of materials which otherwise would go to waste.

Oersted, in 1819–1820, puzzling over the possible relations of voltaic electricity to magnetism, noticed that a conductor carrying an electrical current becomes itself a magnet and deflects the needle. Sturgeon, working along the same lines, found that soft iron enclosed in a coil, through which a current passes, becomes magnetic, but loses the power when the current ceases. This opened the way for our own Henry's all-important discovery of the reciprocating electro-magnets and the vibrating armature—the essential parts of the magnetic telegraph. Henry actually constructed a telegraph in 1832, winding the wires around his class-room in Albany and using a bell to record the making and breaking signals. Here, as he fully recognized, was everything but a simple device for receiving signals.

Several years later Professor Morse, dreaming night and day of the telegraph, was experimenting with Moll's electro-magnet and finding only discouragement. His colleague, Professor Gale, advised him to discard the even then antiquated apparatus and to utilize the results given in Henry's discussion. At once the condition was changed, and soon the ingenious recording instrument bearing Morse's name was constructed. Henry's scientific discoveries were transmuted by the inventor's ingenuity into substantial glory for Morse and proved a source of inconceivable advantage to the whole civilized world. Steinhal's discovery that the earth can be utilized for the return current completed the series of fundamental discoveries, and since that time everything has been elaboration.

Oersted's discovery respecting the influence of an electric current, closely followed by that of Arago in the same direction, opened the way for Faraday's complete discovery of induction, which underlies the construction of the dynamo. This ascertained, the province of the inventor was well defined—to conjure some mechanical

appliance whereby the principle might be utilized. But here, as elsewhere, the work of discovery and that of invention went on almost *pari passu;* the results of each increased those of the other. The distance from the Clark and Page machines of the middle thirties, with their cumbrous horseshoe magnets and disproportionate expenditure of power, to the Siemens machine of the fifties was long; but it was no leap. In like manner, slow steps marked progress thence to the Gramme machine, in which one finds the outgrowth of many years of labor by many men, both investigators and inventors. In 1870, forty years after Faraday's announcement of the basal principle, the stage was reached whence progress could be rapid. Since that time the dynamo has been brought into such stage of efficiency that the electro-motor seems likely to displace not merely the steam engine, but also other agencies in direct application of force. The horse is passing away and the trolley road runs along the country highway; the longer railways are considering the wisdom of changing their power; cities are lighted brilliantly where formerly the gloom invited highwaymen to ply their trade; and even the kitchen is invaded by new methods of heating.

Long ago it was known that, if the refining of pig iron be stopped just before the tendency to solidify became pronounced, the wrought iron is more durable than that obtained in the completed process. Thus imperfectly refined metal was made frequently, though unintentionally and ignorantly. A short railroad in southwestern Pennsylvania was laid in the middle sixties with iron rails of light weight. A rail's life in those days rarely exceeded five years; yet some of those light rails were in excellent condition almost fifteen years afterwards, though they had carried a heavy coke traffic for several years. But this process was uncertain, and the best puddlers could never tell when to stop the process in order to obtain the desired grade.

When a modification of this refining process was attempted on a grand scale almost contemporaneously by Martien in this country and Bessemer in England the same uncertainty of product was encountered; sometimes the process was checked too soon, at others pushed too far. Here the inventor came to a halt. He could use only what was known and endeavor to improve methods of application. Under such conditions the Bessemer process was apparently a hopeless failure. Another, however, utilized the hitherto ignored work of the closet investigator. The influence of manganese in counteracting the effects of certain injurious substances and its relation to carbon when present in pig iron were understood as matters of scientific interest. Mushet recognized the bearing of these facts and used them in changing the process. His method proved successful; but, with thorough scientific forgetfulness of the main chance, he neglected to pay some petty fees at the Patent Office, and so reaped neither profit nor popular glory for his work.

The Mushet process having proved the possibility of immediate and certain conversion, the genius of the inventor found full scope. The change in form and size of the converter, the removable base, the use of trunnions and other details, largely due to the American, Holley, so increased the output and reduced the cost that Bessemer steel soon displaced iron and the world passed from the age of iron into the age of steel.

Architectural methods have been revolutionized. Buildings ten stories high are commonplace; those of twenty no longer excite comment, and one of thirty arouses no more than a passing pleasantry respecting possibilities at the top. Such buildings were almost impossible a score of years ago,

and the weight made the cost prohibitive. The increased use of steel in construction seems likely to preserve our forests from disappearance.

In other directions the gain through this process has been more important. The costly, short-lived iron rail has disappeared and the durable steel rail has taken its place. Under the moderate conditions of twenty-five years ago, iron rails rarely lasted for more than five years; in addition, the metal was soft, the limit of load was reached quickly, and freight rates, though high, were none too profitable.

But all changed with the advent of steel rails as made by the American process. Application of abstruse laws, discovered by men unknown to popular fame, enabled inventors to improve methods and to cheapen manufacture until the first cost of steel rails was less than that of iron. The durability of the new rails and their resistance to load justified increased expenditure in other directions to secure permanently good condition of the roadbed. Just here our fellow member, Mr. P. H. Dudley, made his contribution, whose importance can hardly be overestimated. With his ingenious recording apparatus, it is easy to discover defects in the roadway and to ascertain their nature, thus making it possible to devise means for their correction and for preventing their recurrence. The information obtained by use of this apparatus has led him to change the shape and weight of rails, to modify the type of joints and the methods of ballasting, so that now a roadbed should remain in good condition and even improve during years of hard use.

But the advantages have not inured wholly to the railroad companies. It is true that the cost of maintenance has been reduced greatly; that locomotives have been made heavier and more powerful; that freight cars carry three to four times as much as they did twenty-five years ago, so that the whole cost of operation is very much less than formerly. But where the carrier has gained one dollar the consumer and shipper have gained hundreds of dollars. Grain and flour can be brought from Chicago to the seaboard as cheaply by rail as by water; the farmer in Dakota raises wheat for shipment to Europe. Coal mined in West Virginia can be sold on the docks of New York at a profit for less than half the freight of twenty-five years ago. Our internal commercial relations have been changed, and the revolution is still incomplete. The influence of the Holley-Mushet-Bessemer process upon civilization is hardly inferior to that of the electric telegraph.

Sixty years ago an obscure German chemist obtained an oily liquid from coal-tar oil, which gave a beautiful tint with calcium chloride; five years later another separated a similar liquid from a derivative of coal-tar oil. Still later, Hofmann, then a student in Liebig's laboratory, investigated these substances and proved their identity with an oil obtained long before by Zinin from indigo, and applied to them all Zinin's term, Anilin. The substance was curiously interesting and Hofmann worked out its reactions, discovering that with many materials it gives brilliant colors. The practical application of these discoveries was not long delayed, for Perkins made it in 1856. The marvelous dyes, beginning with Magenta and Solferino, have become familiar to all. The anilin colors, especially the reds, greens and blues, are among the most beautiful known. They have given rise to new industries and have expanded old ones. Their usefulness led to deeper studies of coal-tar products, to which is due the discovery of such substances as antipyrin, phenacetin, ichthyol and saccharin, which have proved so important in medicine.

One is tempted to dwell for a little upon meteorology, that border land where phys-

ics, chemistry and geology meet, and to speak of the Signal Service system, the outgrowth of the studies of an obscure school teacher in Philadelphia, but the danger of trespassing too far upon your endurance makes proper only this passing reference.

While men of wealth and leisure wasted their energies in literary and philosophical discussions respecting the nature and origin of things, William Smith, earning a living as a land surveyor, plodded over England, anxious only to learn, in no haste to explain. His work was done honestly and slowly; when finished as far as possible with his means, it had been done so well that its publication checked theorizing and brought men back to study. His geological map of England was the basis upon which the British Survey began to prepare the detailed sheets showing Britain's mineral resources.

In our country Vanuxem and Morton early studied the New Jersey Cretaceous and Eocene, containing vast beds of marl. Scientific interest was aroused and eventually a geological survey of the State was ordered by the Legislature. The appropriation was insignificant and many of the Legislators voted for it hoping that some economic discovery might be made to justify their course in squandering the people's money. Yet there were lingering doubts in their minds and some found more than lingering doubts in the minds of their constituents. But when the marls were proved to contain materials which the chemist Liebig had shown to be all-important for plants the conditions were changed and criticism ceased. The dismal sands of eastern New Jersey, affording only a scanty living for pines and grasses, were converted, by application of the marl, into gardens of unsurpassed fertility. Vanuxem's study of the stratigraphy and Morton's study of the fossils had made clear the distribution of the marls, and the survey scattered the information broadcast.

Morton and Conrad, with others scarcely less devoted, labored in season and out of season to systematize the study of fossil animals. There were not wanting educated men who wondered why students of such undoubted ability wasted themselves in trifling employment instead of doing something worthy of themselves so as to acquire money and fame. Much nearer to our own time there were wise Legislators who questioned the wisdom of 'wasting money on pictures of clams and salamanders,' though the same men appreciated the geologist who could tell them the depth of a coal bed below the surface. But the lead diggers of Illinois and Iowa long ago learned the use of paleontology, for the 'lead fossil' was their guide in prospecting. The importance and practical application of this science, so largely the outgrowth of unappreciated toil in this country as well as in Europe, is told best in Professor Hall's reply to a patronizing politician's query: "And what are your old fossils good for?" "For this, take me blindfolded in a balloon; drop me where you will; if I can find some fossils I'll tell you in ten minutes for what minerals you may look and for what minerals you need not look."

Many regard Botany as a pleasing study, well fitted for women and dilletanti, but hardly deserving attention by strong men. Those who speak thus only exercise the prerogative of ignorance, which is to despise that which one is too old or too lazy to learn. The botanist's work is not complete when the carefully-gathered specimen has been placed in the herbarium with its proper label. That is but the beginning, for he seeks the relations of plants in all phases. In seeking these he discovers facts which often prove to be of cardinal importance. The rust which destroys wheat in the last stage of ripening, the disgusting

fungus which blasts Indian corn, the poisonous ergot in rye, the blight of the pear and other fruits, fall as much within the botanist's study as do the flowers of the garden or the Sequoias of the Sierra. Not a few of the plant diseases which have threatened famine or disaster have been studied by botanists unknown to the world, whose explanations have led to palliation or cure.

The ichthyologist, studying the habits of fishes, discovered characteristics which promptly commended themselves to men of practical bent. The important industry of artificial fertilization and the transportation of fish eggs, which has enabled man to restock exhausted localities and to stock new ones, is but the outgrowth of closet studies which have shown how to utilize Nature's superabundant supply.

The entomologist has always been an interesting phenomenon to a large part of our population. Insects of beauty are attractive, those of large size are curious, while many of the minuter forms are efficient in gaining attention. But that men should devote their lives to the study of the unattractive forms is to many a riddle. Yet Entomology yields to no branch of science in the importance of its economic bearings. The study of the life habits of insects, their development, their food, their enemies, a study involving such minute detail as to shut men off from many of the pleasures of life and to convert them into typical students, has come to be so fraught with relations to the public weal that the State Entomologist's mail has more anxious letters than that of any other officer.

Insects are no longer regarded as visitations from an angry deity, to be borne in silence and with penitential awe. The intimate study of individual groups has taught in many cases how to antagonize them. The scab threatened to destroy orange culture in California; the Colorado beetle seemed likely to ruin one of our important food crops; minute aphides terrified raisers of fruit and cane in the Sandwich Islands. But the scab is no longer a frightful burden in California; the potato bug is now only an annoyance, and the introduction of lady birds swept aphides from the Sandwich Islands. The gypsy moth, believed for more than a hundred years to be a special judgment, is no longer thought of as more than a very expensive nuisance. The curculio, the locust, the weevil, the chinch bug and others have been subjected to detailed investigation. In almost all cases methods have been devised whereby the ravages have been diminished. Even the borers, which endangered some of the most important timber species, are now understood and the possibility of their extermination has been changed into probability.

Having begun with the 'infinitely great,' we may close this summary with a reference to the 'infinitely small.' The study of fermentation processes was attractive to chemists and naturalists, each claiming ownership of the agencies. Pasteur, with a patience almost incredible, revised the work of his predecessors and supplemented it with original investigations, proving that a very great part of the changes in organic substances exposed to the atmosphere are due primarily to the influence of low animals or plants whose germs exist in the atmosphere.

One may doubt whether Pasteur had any conception of the possibilities hidden in his determination of the matters at issue. The canning of meats and vegetables is no longer attended with uncertainty, and scurvy is no longer the bane of explorers; pork, which has supplied material for the building of railroads, the digging of canals, the construction of ships, can be eaten without fear. Flavorless butter can be rendered delicious by the introduction of the proper bacteria; sterilized milk saves the lives of many chil-

dren; some of the most destructive plagues are understood and the antidotes are prepared by the culture of antagonistic germs; antiseptic treatment has robbed surgery of half its terrors, and has rendered almost commonplace operations which, less than two decades ago, were regarded as justifiable only as a last resort. The practice of medicine has been advanced by outgrowths of Pasteur's work almost as much as it was by Liebig's chemical investigations more than half a century ago.

In this review the familiar has been chosen for illustration in preference to the wonderful, that your attention might not be diverted from the main issue, that the foundation of industrial advance was laid by workers in pure science, for the most part ignorant of utility and caring little about it. There is here no disparagement of the inventor; without his perception of the practical and his powers of combination the world would have reaped little benefit from the student's researches. But the investigator takes the first step and makes the inventor possible. Thereafter the inventor's work aids the investigator in making new discoveries, to be utilized in their turn.

Investigation, as such, rarely receives proper recognition. It is usually regarded as quite a secondary affair, in which scientific men find their recreation. If a geologist spends his summer vacation in an effort to solve some perplexing structural problem he finds, on his return, congratulations because of his glorious outing; the astronomer, the physicist and the chemist are all objects of semi-envious regard, because they are able to spend their leisure hours in congenial amusements; while the naturalist, enduring all kinds of privation, is not looked upon as a laborer, because of the physical enjoyment which most good people think his work must bring.

It is true that investigation, properly so-called, is made secondary, but this is because of necessity. Scientific men in government service are hampered constantly by the demand for immediately useful results. Detailed investigation is interrupted because matters apparently more important must be considered. The conditions are even more unfavorable in most of our colleges and none too favorable in our greater universities. The 'literary leisure' supposed to belong to college professors does not fall to the lot of teachers of science, and very little of it can be discovered by college instructors in any department. The intense competition among our institutions requires that professors be magnetic teachers, thorough scholars, active in social work, and given to frequent publication, that, being prominent, they may be living advertisements of the institution. How much time, opportunity or energy remains for patient investigation some may be able to imagine.

The misconception respecting the relative importance of investigation is increased by the failure of even well educated men to appreciate the changed conditions in science. The ordinary notion of scientific ability is expressed in the popular saying that a competent surgeon can saw a bone with a butcher knife and carve muscle with a handsaw. Once, indeed, the physicist needed little aside from a spirit lamp, test tubes and some platinum wire or foil; low power microscopes, small reflecting telescopes, rude balances and home-made apparatus certainly did wonderful service in their day; there was a time when the finder of a mineral or fossil felt justified in regarding it as new and in describing it as such; when a psychologist needed only his own great self as a basis for broad conclusions respecting all mankind. All of that belonged to the infancy of science, when little was known and any observation was liable to be a discovery; when a Humboldt, an Arago or an Agassiz was possible. But

all is changed; workers are multiplied in every land; study in every direction is specialized; men have ceased the mere gathering of facts and have turned to the determination of relations. Long years of preparation are needed to fit one to begin investigation; familiarity with several languages is demanded; great libraries are necessary for constant reference, and costly apparatus is essential even for preliminary examination. Where tens of dollars once supplied the equipment in any branch of science, hundreds, yes thousands, of dollars are required now.

Failure to appreciate the changed conditions induces neglect to render proper assistance. As matters now stand, even the wealthiest of our educational institutions cannot be expected to carry the whole burden, for endowments are insufficient to meet the too rapidly increasing demand for wider range of instruction. It is unjust to expect that men, weighted more and more by the duties of science teaching, involving, too often, much physical labor from which teachers of other subjects are happily free, should conduct investigations at their own expense and in hours devoted by others to relaxation. Even were the pecuniary cost comparatively small, to impose that would be unjust, for, with few exceptions, the results are given to the world without compensation. Scientific men are accustomed to regard patents much as regular physicians regard advertising.

America owes much to closet students as well as to educated inventors who have been trained in scientific modes of thought. The extraordinary development of our material resources—our manufacturing, mining and transporting interests—shows that the strengthening of our educational institutions on the scientific side brings actual profit to the community. But most of this strengthening is due primarily to unremunerated toil of men dependent on the meagre salary of college instructors or government officials in subordinate positions. Their aptitude to fit others for usefulness, coming only from long training, was acquired in hours stolen from sleep or from time needed for recuperation. But the labors of such men have been so fruitful in results that we can no longer depend on the surplus energy of scientific men, unless we consent to remain stationary. If the rising generation is to make the most of our country's opportunities it must be educated by men who are not compelled to acquire aptness at the cost of vitality. The proper relation of teaching labor to investigation labor should be recognized, and investigation, rather than social, religious or political activity, should be a part of the duty assigned to college instructors.

Our universities and scientific societies ought to have endowments specifically for aid in research. The fruits of investigations due to Smithson's bequest have multiplied his estate hundreds of times over to the world's advantage. He said well that his name would be remembered long after the names and memory of the Percy and Northumberland families had passed away. Hodgson's bequest to the Smithsonian is still too recent to have borne much fruit, but men already wonder at the fruitfulness of a field supposed to be well explored. Nobel knew how to apply the results of science; utilizing the chemist's results, he applied nitro-glycerine to industrial uses; similarly he developed the petroleum industry of Russia and, like that of our American petroleum manufacturers, his influence was felt in many other industries of his own land and of the Continent. At his death he bequeathed millions of dollars to the Swedish Academy of Sciences that the income might be expended in encouraging pure research. Smithson, Hodgson and Nobel have marked out a path which should be crowded with Americans.

The endowment of research is demanded now as never before. The development of technical education, the intellectual training of men to fit them for positions formerly held by mere tyros, has changed the material conditions in America. The surveyor has disappeared—none but a civil engineer is trusted to lay out even town lots; the founder at an iron furnace is no longer merely a graduate of the casting house—he must be a graduate in metallurgy; the manufacturer of paints cannot entrust his factory to any but a chemist of recognized standing; no graduate from the pick is placed in charge of mines—a mining engineer alone can gain confidence; and so everywhere. With the will to utilize the results of science there has come an intensity of competition in which victory belongs only to the best equipped. The profit awaiting successful inventors is greater than ever and the anxious readiness to apply scientific discoveries is shown by the daily records. The Röntgen rays were seized at once and efforts made to find profitable application; the properties of zirconia and other earths interested inventors as soon as they were announced; the possibility of telegraphing without wires incited inventors everywhere as soon as the principle was discovered.

Nature's secrets are still unknown and the field for investigation is as broad as ever. We are only on the threshold of discovery and the coming century will disclose wonders far beyond any yet disclosed. The atmosphere, studied by hundreds of chemists and physicists for a full century, proved for Rayleigh and Ramsay an unexplored field within this decade. We know nothing yet. We have gathered a few large pebbles from the shore, but the mass of sands is yet to be explored.

And now the moral has been drawn. The pointing is simple. If America, which, more than other nations, has profited by science, is to retain her place, Americans must encourage, even urge research; must strengthen her scientific societies and her universities, that under the new and more complicated conditions her scientific men and her inventors may place and keep her in the front rank of nations.

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RECENT PROGRESS IN MALACOLOGY.

THE literature of the Rudistes in America is very scant. One of the important contributions to it that has yet appeared is due to Professor R. P. Whitfield,* who has recently described an interesting collection from the Cretaceous rocks of Jamaica. This comprises six species of *Radiolites*, one of *Caprina*, two of *Caprinella* and one of *Caprinula*. The descriptions are accompanied by excellent photo-engravings of the specimens, one of which reaches eighteen inches in diameter. In the same Bulletin† Professor Whitfield prints some extremely interesting observations on the problematical organism called *Barrettia*, first described by Woodward in 1862, from the Cretaceous limestones of Jamaica. The specimens which form the subject of the present article include, beside the original type of the genus, two new species which, with the others, are lavishly illustrated. *Barrettia* was first regarded as one of the Rudistæ though certain features analogous to coral structure were pointed out by Woodward. Whitfield's observations, though not claimed as decisive, lead in the latter direction and indicate that this singular fossil is probably related to the operculate corals, though from many points of view widely separated from any of the corals hitherto recognized as such. It may be mentioned that the

* Bull. Am. Mus. Nat. Hist. IX., Art. XI., pp. 185-196, Pl. VI.-XXII., New York, 1897.

† Op. cit., Art XX., pp. 233-246, Pl. XXVII.-XXXVIII.

peripheral structure of *Barrettia* strongly recalls that of some of the parasitic balani.

The year-book for 1896 of the Museum at Bergen, Norway, where so much excellent zoological work has been done in past years, by Daniellsen, Nansen and others, has recently been distributed. The leading paper in this volume* is an investigation of the eyes of *Pecten* and *Lima* by K. E. Schreiner. Anyone who has ever examined a living scallop has been struck by the jewel-like beauty of the brilliantly colored eyes on the edge of the mantle. These are shown by Schreiner to possess a rather high type of organization, the details of which are carefully worked out and fully illustrated. A considerable number of species was examined. On the other hand, the allied genus *Lima*, represented by the gigantic deep-water *L. excavata*, has a very low type of visual organ, a mere open pit lined with pigmented epithelium, much like the analogous organs in *Patella*. In the same volume† James A. Grieg contributes an article on the Vestland mollusks, including several nudibranchs new to the region. Anatomical details in regard to a variety of *Tritonia plebeia* are recorded. Felix Bernard has continued the excellent researches on the development of the hinge-teeth in bivalves, to which we have already called attention in an earlier number of this Journal. In a recent number of the *Journal de Conchyliologie* ‡ he considers a small group of small bivalves for which is proposed the name Condylocardia, and with which he would unite the genera *Carditella* and *Carditopsis* in a special family Condylocardiidæ. These shells he considers to represent a precocious stage of development of the Carditidæ, Astartidæ and Crassatellitidæ. They have an internal resilium, and a striking feature is the near approach to symmetry of the early teeth with respect to the resilium. These small shells are also remarkable in the evidence they afford of the acceleration and retardation of certain characters relative to the time of appearance of such characters in allied groups. Another paper of more than ordinary interest* is on the Anatomy of *Chlamydoconcha orcutti*, a remarkable Californian bivalve, in which the valves are wholly internal and the adductor muscles so reduced that no trace of them remains. The work of M. Bernard in the main confirms the synopsis of characters given by the writer in 1884, exception being made of the anterior orifice of the mantle which proves to open into a *cul de sac* and may represent the point where the final immersion of the valves came to completion. A multitude of details are added to our knowledge of the animal and illustrated in the excellent manner usual with this author. The conclusion is that this mollusk represents the last term in a developmental series, of which *Galeomma* represents an early stage.

In a third paper† M. Bernard describes some interesting new forms, minute bivalves from New Zealand, belonging to the new genera *Pachykellya*, *Cyamiomactra* and *Perrierina*, with others belonging to *Neolepton*. All these are distinguished by marked peculiarities of the armature of the hinge, which are worked out with extreme care. These papers lead us to anticipate with the greatest interest the general work on the hinges of bivalves which M. Bernard has announced as in preparation.

Some years ago Carpenter described a curious little shell from Cape St. Lucas, which he named *Philobrya*, which appeared to be related to the pearl oysters. After-

* Bergen's Museums Aarbog for 1896, pp. 1–51, Pl. I.–IV., 1897.

† Op. cit., Art. X., pp. 32., with one plate.

‡ No. 3, pp. 169-206, 1897, with one plate.

* Ann. Sci. Nat. Zool. Ser. VIII., Vol. IV., pp. 321–252, Pl. 1, 1897.

† Extr. Bull. Mus. d'Hist. Nat. Paris, No. 7, pp. 309–314, 1897.

ward Vélain described another related shell from the islands of St. Paul and Amsterdam, under the name of *Hochstetteria;* and still more recently the writer made known another species of *Philobrya*, dredged by the Albatross on the Argentine coast, and called attention to the fact that the nepionic shell in this genus presented the characters of the *Glochidium* stage of the Unionidæ, and suggested that in *Philobrya* also this might correspond to an encysted parasitic stage. In an excellent paper on *Philobrya* and *Hochstetteria*, Bernard has added greatly to our knowledge, showing that the *Glochidium* in these genera represents a more advanced stage of development, including the presence of a provinculum, absent in the Unionidæ, and that the peculiarities of the shell are probably correlated with a large vitellus in the egg, rather than with any state of parasitic incubation. The soft parts in *Philobrya*, before the dissoconch is developed, have already passed the larval stage. These curious little shells, according to Bernard,* represent an early stage, not so much of any particular genus of Pteriidæ as of the group in general. It is certain, however, that the possession of a glochidial shell by both Unionidæ and the present group is a common character of no little significance, notwithstanding the fact that the inauguration of the dissoconch begins at slightly different stages in the two. Two systematic papers of unusual interest have recently appeared in the Transactions of the Connecticut Academy of Sciences. One by Professor Verrill † discusses the classification of the Pectinidæ, to which the author brings much erudition as well as a wide knowledge of the group. We believe that the subdivision of groups has been carried to an excessive minuteness, yet even this is preferable to the superficial study which slurs over points of difference without consideration. In the second paper Miss Bush * discusses the minute gastropods generally referred to *Cylostrema*, *Adeorbis*, *Vitrinella* and related genera. She shows that an enormous amount of confusion has reigned among them and does much to clear it up, incidentally describing quite a number of new groups to which portions of the assembly are to be referred.

* Journ. de Conchyl. Vol. 45, pp. 1–47, Pl. 1, 1897.

† Vol. X., pp. 41–96, Pl. XVI.–XXI, 1897.

Dr. H. von Ihering, the director of the museum at San Paulo, Brazil, has followed in the steps of Burmeister in his energetic efforts to elucidate the natural history of his adopted country. In the second volume of the Revista do Museu Paulista, recently received, with his report for the year 1897, beside articles on plants, crustaceans, insects and fishes of Brazil, he has published a review of the Arcidæ and Mytilidæ of the Brazilian coast, an enumeration of the molluscan fauna of the Brazilian island of San Sebastian, and one, which is perhaps the most timely of all, on the Mollusks of the Patagonian Tertiary, mostly referable to what Hatcher has so recently shown to be horizons of Miocene age. These are well illustrated with seven very good plates and numerous figures in the text.

The leisurely manner in which scientific publication proceeds in France is well illustrated by two instances which have lately attracted attention. One is the announcement of the final fasciculus of the monumental work of Crosse and Fischer on the land and fresh-water mollusks of Mexico, which is a report of the authors on material collected during the ill-fated expedition of Maximilian more than thirty years ago. To this has been added much from other sources and valuable anatomical work, indispensable to all students of the subject, as well as a wealth of illustration of the highest quality. We can only lament that the junior author did not survive to see the completion of the publication.

* Op. cit., pp. 97–144, Pl. XXII.–XXIII., 1897.

The other case is that of the Report on the Mollusks of the deep-sea dredging expeditions sent out by France, 1880–83, in the Travailleur and Talisman. The first volume of this report by Arnould Locard,* on the Testaceous Mollusks, includes the Cephalopods, Pteropods and Gastropods as far as Litiopidæ. It is illustrated by excellent lithographic plates and is chiefly descriptive. A superficial examination gives the impression that the abyssal fauna of the eastern Atlantic does not materially differ in character from that of the American border of the same ocean, but that, so far as it does differ, it confirms the impression that the abyssal mollusk fauna of any coast is strongly tinctured with the faunal characteristics of the shallow waters of that coast; so that, while there are some ubiquitous or almost ubiquitous species and many ubiquitous genera, the deep-sea fauna will eventually be divisible into almost as many provinces as there are recognizable among the different faunas of the sea margin.

We congratulate the author on the appearance of this weighty instalment of his work, and desire to assure him that we also know what it is to publish through a government printing office.

WM. H. DALL.

ON THE LAW OF ANCESTRAL HEREDITY.†

THE Darwinian theory has for its main factor the perpetuation of favorable variations by natural selection under the law of heredity. Hence any complete quantitative treatment of evolution must deal: (1) with the nature and distribution of variation; (2) with the nature and influence of selection, and this not only upon the selected but upon all the correlated characters or organs; and (3) with the law of heredity. Earlier published and other written but unpublished papers of the present writer cover to some extent the ground of (1) and (2). Although the mathematical theory of variation and selection is yet very far from completion, the general lines on which it will proceed seem, to the present writer at any rate, fairly clear. With the law of heredity, however, the case has hitherto been different. Much has been written on the subject, much has been attributed to inheritance, but the quantitative measurements and facts have formed such a small and slender proportion of the whole that it has been extremely difficult to base a rounded mathematical theory on what is really known. It was with a view to the collection of further facts that the writer started his collection of Family Measurements, which would now have reached completion were it not that certain collateral relationships are still numerically somewhat deficient. Such facts are so all-important for real progress in our knowledge of heredity that the writer is convinced that there ought to be a comprehensive and systematic collection of them by some public body; the labor is beyond the powers of any unaided individual.

When the writer of the present paper wrote his memoir on Heredity, in 1895,* the only available material was contained in Mr. Francis Galton's *Natural Inheritance*, and in the data and measurements in Mr. Galton's hands, which he at once placed, with his usual generosity, at the writer's disposal. The very suggestive theory of heredity developed in the *Natural Inheritance* has two main features: (*a*) a theory of regression, which states the average proportion of any character which will be inherited under any degree of relationship. This theory was very simple; if the aver-

*4°, pp. iv + 516, Pl. I.–XXII.; Paris, Masson et Cie., 1897.

†'Mathematical Contributions to the Theory of Evolution.' Abstract of a paper read before the Royal Society by Professor Karl Pearson, F.R.S., University College, London, January 27, 1898.

* *Phil. Trans.*, Vol. 187, A, p. 253.

age of the sons of any parent had w of the parent's deviation from the average parent, then the average grandson would have w^2 of the deviation, and so on. Collateral heredity was also determined, and for two brothers was found equal to $2w$. Mr. Galton's value of w was $\frac{1}{3}$.

(*b*) A law of ancestral heredity. According to this law the two parents contribute $\frac{1}{4}$, the four grandparents $\frac{1}{8}$, the eight great-grandparents $\frac{1}{16}$, and so on, of the total heritage of the average offspring. Mr. Galton, in 1889, considered this law to rest on a somewhat slender basis.*

In the *Philosophical Transactions* memoir of 1895 the writer started from the general theory of multiple correlation, and supposed the coefficient of heredity to be a quantity which had to be determined by observation for each pair of relatives and for each character. Mr. Galton's own data, when treated by the fuller mathematical theory developed in that memoir, seemed to demonstrate that fraternal could not possibly be twice filial inheritance. But if heredity be looked upon as a quantity to be determined by observation for each organ and each grade of kinship, *e. g.*, if there be no numerical relationship between direct and collateral heredity, then Mr. Galton's law of ancestral heredity must fall to the ground. Accordingly the writer, in 1895, discarded (*b*) and endeavored to develop (*a*) on the general basis of multiple correlation.

The recent publication of Mr. Galton's remarkable paper on ancestral heredity in Bassett hounds has, however, led the writer to reconsider (*b*). If the law be true, then for every organ and for every grade of kinship the amount of heredity is numerically determinable. The solution of the problem of heredity is thrown back upon the solution of an infinite series of linear equations. Their solution gives results which seem to

* *Natural Inheritance*, p. 136.

the writer in good agreement with all we at present know about the influence of heredity in various degrees of kinship. For example, fraternal is no longer *twice* filial regression, but has a value (0.3881) well in accordance with the writer's 1895 calculations on Mr. Galton's data. In short, if we discard Mr. Galton's relations between the regressions for various grades of kinship, and start solely from his law of ancestral heredity,* the whole theory of heredity becomes simple, luminous, and well in accordance with such quantitative measurements as have so far been made. That it confutes one or two purely hypothetical and semi-metaphysical theories is no disadvantage.

It is possible, and the writer believes desirable, to somewhat generalize the Law of Ancestral Heredity. Modifying Mr. Galton's definition of midparent, a conception is formed of the mid-sth parent, a sort of mean of the ancestry in the sth generation, and the contribution of this mid-sth parent to the offspring is assumed to have a constant ratio to that of the mid-$(s+1)$th parent, whatever be the value of s. With this simple law the whole of heredity is found to depend upon a single constant γ, termed the *coefficient of heredity*. γ may vary from organ to organ and from race to race. It may itself be subject to selection, if heredity be not looked upon as *a priori* given and antecedent to any evolution by natural selection. In Mr. Galton's statement of the law, $\gamma = 1$. This may really be the case, but it is not necessary to the theory, and it is not required by any facts as yet observed.

Given this simple law of ancestral heredity, there flow from it the following results :

* It may be *popularly* stated thus, each group of ancestry of the same grade contributes to the heritage of the average offspring double the quantity of the group of the grade above it.

(i) The values of all the correlation and regression coefficients between any pair of relations, *i. e.*, heredity between any grade of individual kinship. The chief of these are actually calculated in the paper.

(ii) The value of the stability that results from any long or short process of selective breeding, and the variability of the breed so established. A coefficient of stability is introduced in the paper and discussed at some length. The consideration of the more rapid influence of in- and inbreeding is postponed.

(iii) The law of cross heredity, *i. e.*, the degree of relationship between two *different* organs in kindred. It is shown that the coefficient of cross heredity for any pair of organs in any grade of kindred is equal to the product of the coefficient of direct heredity in that grade into the coefficient of organic correlation.

(iv) That simple panmixia without active reversal of natural selection does not lead to degeneration.

It may be of interest to add that since the law of ancestral heredity allows for the variability of each individual ancestor from the ancestral type, giving that variability its share in the heritage of the offspring, it is inconsistent with Weismann's theory of the germplasma. It does not, of course, answer one way or the other the question as to the inheritance of acquired characters.

To sum up, then, it seems to the present writer that Galton's law of ancestral heredity leads to, what has not hitherto existed, a rounded and comprehensive theory of heredity. It describes with surprising closeness all facts so far quantitatively determined, and opens up a wide range of conclusions which await testing by fresh data. Should those data be in agreement with its predictions, then the law of ancestral heredity will in the future play as large a part in the theory of evolution as the law of gravitation has played in planetary theory. It is the quantitative basis on which Darwinism, the evolution of species by natural selection *combined with heredity*, will then be placed; and at one stroke it will clear away a veritable jungle of semi-metaphysical speculations and hypotheses, and this for the simple reason that it is based upon quantitative observations and not on verbal subtleties. It will be difficult, perhaps, to make people realize that there is a science of heredity, simple and consistent, in existence; yet even at the present time it is the number of observers and experimenters, rather than the science, which needs to be strengthened.

THE ROYAL SOCIETY'S ANTARCTIC CONFERENCE.

THE Royal Society held an important meeting on February 24th for the purpose of discussing Antarctic exploration, which is at present engaging the attention of the British government. We take from the London *Times* the following account of the discussion:

Dr. John Murray, of the Challenger Expedition, said that, from a scientific point of view, the advantages to be derived from a well-equipped and well-directed expedition to the Antarctic region would, at the present time, be manifold. Every department of natural knowledge would be enriched by systematic observations as to the order in which phenomena coexist and follow each other in regions of the earth's surface about which we knew very little or were wholly ignorant. It was one of the great objects of science to collect observations of the kind indicated, and it might be safely said that without them we could never arrive at a right understanding of the phenomena by which we were surrounded, even in the habitable parts of the globe. Dr. Murray pointed out a fundamental topographical difference between the Arctic and Antarctic. In the northern

hemisphere there was a polar sea almost completely surrounded by continental land, and continental conditions for the most part prevailed. In the southern hemisphere, on the other hand, there was almost certainly a continent at the South Pole which was completely surrounded by the ocean, and, in those latitudes, the most simple and extended oceanic conditions on the surface of the globe were encountered.

With reference to the atmosphere, Dr. Murray said that one of the most remarkable features in the meteorology of the globe was the low atmospheric pressure at all seasons in the southern hemisphere south of latitude 45° S., with the accompanying strong westerly and northwesterly winds, large rain and snow fall, all round the South Polar regions. There were, he believed, many indications that the extreme South Polar area was occupied by a vast anti-cyclone, out of which winds blew towards the girdle of low pressure outside the ice-bound region. The anti-cyclonic area at the South Pole appeared to be permanent, and, when in winter the sea-ice was for the most part continuous, and extended far to the north, the anti-cyclonic area had most probably a much wider extension than in summer. All observations in high southern latitudes indicated an extremely low summer temperature. In winter we had no direct observations. It was most likely that the prevailing winds blew out from the Pole all the year round towards the surrounding sea, as in the case of Greenland; but, unlike Greenland, this area was probably seldom traversed by cyclonic disturbances. But what had been stated only showed how little real knowledge we possessed concerning the atmospheric conditions of high southern latitudes. It was certain, however, that even two years' systematic observations within these regions would be of the utmost value for the future of meteorological science.

Dr. Murray next dealt with the Antarctic ice. From many points of view it would be important to learn something about the condition and distribution of Antarctic sea-ice during the winter months, and especially about the position of the huge table-shaped icebergs at this and other seasons of the year. These flat-topped icebergs, with a thickness of 1,200 ft. or 1,500 ft., with their stratification and their perpendicular cliffs, rising 150 ft. or 200 ft. above and sinking 1,100 ft. or 1,400 ft. below the level of the sea, formed the most striking peculiarity of the Antarctic Ocean. Their form and structure seemed clearly to indicate that they were formed on an extended land surface and had been pushed out over low-lying coasts into the sea. Ross sailed for 300 miles along the face of a great ice-barrier from 150 ft. to 200 ft. in height, off which he obtained depths of 1,800 ft. and 2,400 ft. All Antarctic land was not, however, surrounded by such inaccessible cliffs of ice. Kristensen and Borchgrevink landed on a pebbly beach, occupied by a penguin rookery, at Cape Adare without encountering any land-ice descending to the sea. Where a penguin rookery was situated we might be quite sure that there was occasionally open water for a considerable portion of the year, and that consequently landing might be effected without much difficulty or delay; and, further, that a party, once landed, might with safety winter at such a spot, where the penguins would furnish an abundant supply of food and fuel. A properly equipped party of observers situated at a point like this on the Antarctic continent for one or two winters might carry out a most valuable series of scientific observations, make successful excursions toward the interior, and bring back valuable information as to the probable thickness of the ice-cap, its temperature at different levels, its rate of accumulation, and its motions, concerning all of

which points there was much difference of opinion among scientific men. Was there an Antarctic continent? Dr. Murray pointed out that the lithological specimens which had been collected from the floor of the Antarctic Ocean, dropped there from icebergs—gneisses, granites, mica-schists, quartziferous diorites, grained quartzites, sandstones, limestones and shales—were distinctively indicative of continental land, and there could be no doubt about their having been transported from land situated towards the South Pole. From these and from specimens, including fossils, from off the land itself, we were thus in possession of abundant indications that there was a wide extent of continental land within the ice-bound regions of the southern hemisphere. The fossil remains indicated in these areas a much warmer climate in past times. It was not likely that any living land fauna would be discovered on the Antarctic continent away from the penguin rookeries. Still, an Antarctic expedition would certainly throw much light on many geological problems.

Dr. Murray went on to speak of magnetic and pendulum observations, geodetic measurements, tides and currents. In any Antarctic expedition, he said, magnetic observations would, of course, form an essential part of the work to be undertaken, and the importance of such observations had been frequently dwelt upon by eminent physicists and navigators. It might be possible to measure a degree on the Antarctic continent or ice-cap, which would be a most useful thing to do. By watching the motions of the icebergs and ice from land at Cape Adare much would be learnt about oceanic currents, and our knowledge of the tides would be increased by a systematic series of tidal observations on the shores of the Antarctic continent, where we had at present no observations. The series of scientific observations here indicated would fill up many other gaps in our knowledge of the physical conditions of these high southern latitudes.

With regard to the depth of the Antarctic Ocean, the few indications which we possessed seemed to show that there was a gradual shoaling of the ocean from very deep water towards the Antarctic continent, and so far as we yet knew, from either soundings or temperature observations, there were no basins cut off from general oceanic circulation by barriers or ridges, similar to those found in the Arctic. Further samples in addition to those already obtained from different depths in the unexplored regions would yield most interesting information. As to the mean daily temperature of the surface waters of the Antarctic, all observations seemed to show that the surface water was warmer than the air during the summer months. After referring to the Challenger observations on surface and deep-sea temperatures, and to the relations between the Antarctic waters and those of the oceanic waters to the north, Dr. Murray stated that a fuller examination of these waters was most desirable at different seasons of the year, with improved thermometers and sounding machines. Dr. Murray referred in some detail to the pelagic and shallow-water life found in the Antarctic and Sub-Antarctic Ocean, and to the interesting scientific problems connected therewith. He dwelt especially on the many forms which have been found common to both the North and the South Polar Oceans, hinting at a problem of great interest which he discussed in the last volume of the 'Challenger' publications in connection with the former distribution of life in the ocean.

What was urgently required, he said, with reference to the biological problems indicated was a fuller knowledge of the facts, and it could not be doubted that an Antarctic expedition would bring back col-

lections and observations of the greatest interest to all naturalists and physiologists; and without such information it was impossible to discuss with success the present distribution of organisms over the surface of the globe, or to form a true conception of the antecedent conditions by which that distribution had been brought about. There were many directions, Dr. Murray concluded, in which an Antarctic expedition would carry out important observations besides those to which he had alluded. From the purely exploratory point of view much might be urged in favor of an Antarctic expedition at an early date. For the further progress of scientific geography it was essential to have a more exact knowledge of the topography of the Antarctic regions. This would enable a more just conception of the volume relations of land and sea to be formed, and in connection with pendulum observations some hints as to the density of the sub-oceanic crust might be obtained. In case what he had said might possibly have created the impression that we really knew a great deal about the Antarctic regions, it was necessary to re-state that all the general conclusions which he had indicated were largely hypothetical, and he again urged the necessity for a wider and more solid base for generalizations. The results of a successful Antarctic expedition would mark a great advance in the philosophy —apart from the mere facts—of terrestrial science. "No thinking person doubts," Dr. Murray concluded, "that the Antarctic will be explored. The only questions are—when, and by whom? I should like to see the work undertaken at once, and by the British navy. I should like to see a sum of £150,000 inserted in the estimates for the purpose. The government may have sufficient grounds for declining to send forth such an expedition at the present time, but that is no reason why the scientific men of the country should not urge that the exploration of the Antarctic would lead to important additions to knowledge, and that, in the interests of science among English-speaking people the United Kingdom should take not only a large but a leading part in any such exploration."

The Duke of Argyll, who was not present, but had sent a note on the subject, referred to the generally accepted glacial-period theory, with which he disagreed, and pointed out that the Antarctic continent was unquestionably the region of the earth in which glacial conditions were at the *maximum*, and therefore it was the region in which we must look for all the information attainable towards, perhaps, the most difficult problem with which geological science had to deal.

Sir Joseph D. Hooker (who was a member of Sir James Ross's expedition half-a-century ago) said that Dr. Murray's admirable summary of the scientific information obtainable by an organized exploration of the Antarctic regions left nothing further to be said under that head. He could only record the satisfaction with which he heard it read, and his earnest hope that it would lead to action being taken by the government in the direction indicated. Sir Joseph Hooker referred to the vast area of the unknown region which was to be the field for investigation—a region which in its full extension reached from the latitude of 60 S. to the Southern Pole, and embraced every degree of longitude. Referring to the vast ice-fields which covered the Antarctic area, Sir Joseph said that the explorer naturally asked where and how the components of these great fields of ice had their origin, how they arrived at or maintained their present position, what were their rate of progress and courses, and what was their influence on the surrounding atmosphere and ocean. That they orginated over extensive areas of open water in a higher latitude than

they now occupied, that they were formed of frozen ocean water and snowflakes, and that winds and currents had brought them to where we now found them was certain. But of the position of the Southern, open waters, with the exception of the comparatively diminutive sea east of Victoria Land, we knew nothing, nor did we know anything of the relative amount of snow and ice of which they were composed, or of their age, or of the winds and currents, that had carried them to a lower latitude. The other great glacial feature of the Antarctic area was 'the ice Barrier' which Ross traversed for 300 miles in the 78th and 79th degrees of south latitude, maintaining throughout the character of an inaccessible precipitous ice-cliff (the sea front of a gigantic glacier) of 150 ft. to 200 ft. in height. This stupendous glacier was, no doubt, one parent of the huge table-topped ice-island that infested the higher latitudes of the southern ocean; but, as in the case of the pack-ice, we did not know where the barrier had its origin, or anything further about it than that it rested in great part upon a comparatively shallow ocean-bottom. It probably abutted upon land, possibly upon an Antarctic continent. He did not see any other method of settling this important point, except by the use of a captive balloon —an implement with which he hoped any future Antarctic expedition might be supplied. He chose the subject of the Antarctic pack-ice as his theme not only because it was one of the very first of the phenomena that demanded the study of the explorer, but because it was the dominant feature in Antarctic navigation. The Antarctic fauna and flora were most important, for the South Polar Ocean swarmed with animal and vegetable life. So prolific was the Antarctic Ocean that the naturalist need never be idle, no, not even for one of the twenty-four hours of daylight throughout the Antarctic summer; and he looked to the results of a comparison of the oceanic life of the Arctic and Antarctic regions as the heralding of an epoch in the history of biology.

Dr. Nansen said that Great Britain was undoubtedly the country to undertake a great Antarctic expedition, for which the whole scientific world was now waiting impatiently. He confined his remarks to the portance of a land expedition. He was not at all sure whether the Antarctic land was a continent, and not a great group of islands. At all events there must be one or several ice-caps, and the exploration of these would yield scientific information of the greatest value. Geologists were looking to the Antarctic for full light to be thrown on the glacial epoch. It might be difficult to get on the Antarctic inland ice, but not at all impossible. The surface was probably smoother than in Greenland. Observations on the thickness of the ice would yield valuable results. On the other matters referred to by Dr. Murray he was confident that a properly equipped Antarctic expedition would yield excellent results. He pointed out the important influence in meteorology which this enormous ice-sheet must have on the climatology of the whole world. If Great Britain sent out such an expedition, he was sure that Norway would be willing to send out an expedition for coöperation upon the land. We know the conditions of polar exploration now so much better that we could much more readily lay our plans for investigating a region which had such a vast influence on the ocean which England was proud to rule.

Dr. Neumayer, Director of the Hamburg Observatory, said he considered it his duty to attend that meeting in order to show the value he placed on British Antarctic research in the past. He spoke of the urgent need which the science of terrestrial magnetism had of continuous observations in the Antarctic area, if possible simulta-

neously at several stations, by expeditions of various nationalities. He strongly advocated international cooperation, and this suggestion was warmly supported by the meeting. Antarctic exploration must be advocated, and strongly, on purely scientific grounds. Practical results to humanity would follow, as they always had followed scientific research in the past. Terrestrial magnetism was positively at a standstill for lack of *data* from the Antarctic. Dr. Neumayer pointed out, from the few observations made, the intensity of magnetism on the Australian side of the Antarctic compared with what had been found on the opposite side, and the curious coincidence of this with intensity of auroral phenomena. He spoke of Gauss's famous mathematical theory of magnetism, which had stood the test till now; but we were absolutely unable to form a physical theory until we obtained the necessary *data* from Antarctica.

Sir Clements Markham, President of the Royal Geographical Society, fully concurred with every word spoken by Dr. Murray on the subject of the scientific results, and more especially of the geographical results of an Antarctic expedition. It was quite sufficient to point out the vast extent of the unknown area; and that no area of like extent on the surface of the earth ever failed to yield results of practical, as well as of purely scientific, value by its exploration. But there was much more to be said in the present instance, because the little that we did know of the Antarctic regions pointed unmistakably to the very great importance and interest that was certain to attend further research. More complete examination was necessary before any approach to accuracy could be obtained respecting the nature and extent of the supposed ice-cap. We knew that the southern continent was a region of actual volcanic activity; but the extent, nature and effect of this activity remained to be ascertained. On the Antarctic circle, land had been sighted at numerous points, but it was unknown whether what had been seen indicated small islands or a continuous coastline. The extent of the ice-wall and the relations between that and the ice-cap were unknown; as well as the distribution of land and sea, and of ice and water in the summer, and the causes which influenced such distribution. The investigation of each one of these points, and of many others, would lead to further discoveries of the deepest interest to geographical science.

Dr. Alexander Buchan, Secretary of the Scottish Meteorological Society, emphasized the absolute necessity of further meteorological research in the Antarctic before we could form any satisfactory scheme of the climate of the globe.

Sir Archibald Geikie, Director-General of the Geological Survey, said that hardly anything was yet known of the geology of the Antarctic regions. By far the most important contributions to our knowledge of the subject were made by the expedition under Sir James Ross. But as he was unable to winter with his ships in the higher latitudes, and could only here and there with difficulty effect a landing on the coast, most of the geological information brought home by him was gathered at a greater or less distance from the land with the aid of the telescope. We did not know whether the land was a continent or a group of islands. There were indications of Paleozoic rocks, which emphasized the necessity for further research. Among the specimens brought home from Seymour Island in the same district were a few containing some half dozen species of fossil shells, which were believed to point to the existence of Lower Tertiary rocks, one of the organisms resembling a form found in the old Tertiary formations of Patagonia. Large well-developed shells of Cucullæ

and Cytherea undoubtedly indicated the former existence of a far milder climate in these Antarctic seas than now prevailed. If a chance landing for a few hours on a bare islet could give us these interesting glimpses into the geological past of the South Polar regions, what would not be gained by a more leisurely and well-planned expedition? But perhaps the geological domain that would be most sure to gain largely from such exploration would be that which embraced the wide and fascinating field of volcanic action. In the splendid harvest of results brought home by Sir James Ross one of the most thrilling features was the discovery of a volcano rising amid the universal snows to a height of more than 12,000ft., and actively discharging 'flame and smoke,' while other lofty cones near it indicated that they, too, had once been in vigorous eruption. Ross landed on one or two islands near that coast, and brought away some pieces of volcanic rocks. There was other evidence of past and present volcanic action on the Antarctic land. This region was probably one of the most interesting volcanic tracts on the face of the globe. Yet we could hardly be said to know more of it than its mere existence. The deeply interesting problems which it suggested could not be worked out by transitory voyagers. They must be attacked by observers stationed on the spot. Ross thought that a winter station might be established near the foot of Mount Erebus, and that the interior could easily be traversed from there to the magnetic pole. Another geological field where much fresh and important information might be obtained by Antarctic exploration was that of ice and ice-action. Our northern hemisphere was once enveloped in snow and ice, and though for more than half a century geologists had been studying the traces of the operations of this ice-covering they were still far from having cleared up all the difficulties of the study. The Antarctic ice-cap was the largest in the world. Its behavior could probably be watched along many parts of its margin, and this research would doubtless afford great help in the interpretation of the glaciation of the northern hemisphere. To sum up, geologists would hail the organization and dispatch of an Antarctic expedition, in the confident assurance that it could not fail greatly to advance the interests of their science.

Mr. P. L. Sclater, Secretary of the Zoological Society, considered it highly desirable to ascertain more exactly what forms of animal life were to be found on the Antarctic continent and in the adjacent seas. So far animal life in Antarctica has been found to be rather poorly represented. Most of the Antarctic specimens of these animals in our national collection had been obtained during the voyage of the Erebus and Terror, and were now antiquated. In his opinion the special point of interest in the zoology of Antarctica would be the further investigation of its extinct fauna. As in the North Polar region, so in the South Polar continent, it was already positively certain that animals of a character that could not under present conditions possibly exist there were formerly present. Further investigations into this subject would be likely to lead to most important results as regarded the climate of the Polar extremities of the earth in former ages, and would perhaps give us some ideas as to the date at which the ice-caps that now covered them originated. It was therefore of primary importance that in future Antarctic exploration great attention should be paid to the extinct fauna of the South Polar lands.

Professor D'Arcy Thompson (of the Behring Sea Commission) insisted upon the abundance of sea-life at least in the Antarctic, although we had only eight Antarctic dredgings. He believed there was an intimate connection between the Antarctic

and North Pacific, though not with the Atlantic. Admiral Sir William Wharton, Hydrographer to the Admiralty, said that an Antarctic expedition must be under naval discipline. He hoped such an expedition would not be far off, and he felt sure there would be rush of officers and men to join it. Sir John Evans, in summing up, said the discussion had maintained a high level. All were agreed as to the immense advantages of an expedition, and he was sure it would find a warm advocate in the Hydrographer.

ELLIS'S NORTH AMERICAN FUNGI.

TWENTY years ago Mr. J. B. Ellis, of Newfield, N. J., began the distribution of a most important series of volumes containing authentic specimens of the fungi of North America. Many botanists have availed themselves of the opportunity here afforded of securing excellent specimens of all groups of the fungi. For eight years Mr. Ellis worked alone, at the end of which he had issued fifteen volumes ('centuries'), each containing one hundred specimens. He was then joined by Mr. B. M. Everhart, and from this time the series bore the names of both authors. The announcement is now made that this work has been brought to a close.

The importance of being able to fix accurately the date of publication of each of the centuries is so great that the following statement by Mr. Ellis is given for the benefit of the readers of SCIENCE: Century I., September 6, 1878; II., April 15, 1879; III., February 11, 1880; IV., April 20, 1880; V., January 28, 1881; VI. and VII., May 23, 1881; VIII. and IX., April 13, 1882; X. and XI., April 26, 1883; XII. and XIII., April 15, 1884; XIV. and XV., March 25, 1885; XVI. and XVII., March 16, 1886; XVIII. and XIX., March 13, 1887; XX. and XXI., March 23, 1888; XXII. and XXIII., March 6, 1889; XXIV. and XXV., February 19, 1890; XXVI. and XXVII., February 21, 1891; XXVIII., April 30, 1892; XXIX., March 2, 1893; XXX., October 21, 1893; XXXI., April 18, 1894; XXXII., November 26, 1894; XXXIII., March 25, 1895; XXXIV., February 3, 1896; XXXV., December 16, 1896; XXXVI., February 1, 1898.

In regard to the foregoing Mr. Ellis says: "The dates on this sheet are the dates on which the centuries were sent to Charles E. Bessey. Usually when a century (or oftener two centuries) was ready only three or four were sent each day, so that some subscribers received their copies at a later date than others—from one to three weeks in some cases."

As to the number of copies of each century issued Mr. Ellis says: "I am not sure just how many copies of Century I. were issued, but I think there were thirty-five. The number was afterwards increased to forty, and then to fifty, and from Century XVII., to sixty." There were thus about two hundred thousand specimens in this great work. What wonder that the author upon whom the greater part of the labor has fallen should wish rest.

This notice would be incomplete without a reference to the part taken by Mrs. Ellis in the preparation of the volumes. The writer recalls a pleasant letter from Mr. Ellis shortly after the distribution began, in which he spoke of the fact that Mrs. Ellis now bound the books, and that they were better and neater than those of Century I., which came from a professional binder. From that time her hands made all the books (about two thousand), folded most of the papers for the specimens, and pasted the packets into the books.

While the distribution known as the 'North American Fungi' now comes to an end, the authors will continue for a time their second edition under the name of 'Fungi Columbiani.' This was begun in

1893, by the issuance on October 3d of centuries I. and II. Of this distribution sixty copies have been made of each century, and the centuries have now reached XII. This brings the total number of specimens handled in the two series up to about two hundred and seventy thousand.

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CURRENT NOTES ON ANTHROPOLOGY.

ALLEN ON HAWAIIAN SKULLS.

A CRANIOLOGICAL contribution of the first order of merit has just appeared in the Transactions of the Wagner Free Institute of Philadelphia, January, 1898. It is entitled 'A Study of Hawaiian Skulls, by Harrison Allen, M. D.' In this last labor of his busy and useful life Dr. Allen presented a model of patience, accuracy and clearness of statement which it would be difficult to parallel elsewhere. The characteristics of the skulls were exhibited comparatively, by a novel plan, that which he called the 'terrace method,' and which is a great improvement over the older graphic representatians.

With his customary, far-reaching insight into the problems of racial anatomy, Dr. Allen took occasion, in the description of these Polynesian specimens, selected from ancient cemeteries, drawn, therefore, from a single stock of undoubted purity, to point out the changes brought about in skull form by social contrasts, by mental superiority and by differences of nutrition. Comparing them with later crania from the stock, he discovered the singular alterations produced in the skull by exanthematous diseases; and many suggestions stimulating to future students are scattered through his pages.

PRIMITIVE COSMOGONIES.

IN the *Correspondenzblatt* of the German Anthropological Society, December, 1897, is a careful study by the Baron von Andrian on the cosmological and cosmogonical notions of primitive peoples. A wide collection of such myths and a critical analysis of their contents show in far separated centers many strange similarities. These, he argues, must be considered 'autochthonous,' *i. e.*, of independent origin, under the laws of thought and imagination. Later in time, when tribes commingled and the bards and priests sought to impart fixed forms to myths, borrowing arose over areas of varying size. It is the chief duty of the student of to-day to separate the 'common, psychological basic strata' from those which were added later by intercommunication. Quite late elements of mythology, such as the notion of the river Styx, or the tale of Orpheus and Euridice in Greek lore, belong to the primitive thought of the Hellenic stock and were not of alien origin. The article is replete with both erudition and suggestiveness.

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NOTES ON INORGANIC CHEMISTRY.

IT has long been known that that the composition of the 'green iodid' of mercury is far from constant, and is not that which would be theoretically required for mercurous iodid, HgI. Varet has considered that the mercurous iodid exists in two modifications, a green and a yellow, which can be changed the one into the other. The matter has been studied by Maurice François, who gives his results in the *Journ. pharm. chim.* The mercurous iodid is of a pure yellow color, and is readily obtained in this condition by the action of potassium iodid upon an excess of mercurous nitrate in the presence of dilute nitric acid. The green color of the salt as usually obtained is due to the presence of free mercury, which may run up to a very large proportion. It might not be without interest to

investigate how far this presence of free mercury affects the therapeutic value of a salt so largely used for medicinal purposes.

IN the *Comptes Rendus*, P. Ivon describes the use of calcium carbid as a test for absolute alcohol. If any water is present in the alcohol it decomposes the carbid with the evolution of acetylene. Calcium carbid may also be used for the dehydration of alcohol, one part being used to four parts of 90–95 % alcohol. Any acetylene dissolved in the alcohol is removed by anhydrous copper sulfate, and in one, or at least two, distillations the alcohol is rendered absolute.

THE atomic weight of boron is the subject of a paper recently read before the Chemical Society (London) by F. P. Armitage. The method used was the determination of the water of crystallization in borax. Great care was used, both in drying the crystals, so that there should be no efflorescence, and in dehydrating the crystals. The result obtained, 10.959 ($O = 16$), differs but 0.006 from that obtained by Ramsay and Aston by distilling sodium biborate with hydrochloric acid and methyl alcohol. In the discussion which followed the paper there was considerable criticism of depending upon water of crystallization in atomic-weight determinations.

AT the same meeting a paper was presented by E. Sonstadt on the dissociation of potassium chloroplatinate in dilute solutions and the production of platinum monochlorid. When the chloroplatinate is heated in a solution of 10,000 parts water the solution becomes turbid, and after some days' heating a precipitate is formed, yellow and non-crystalline, and consisting, according to the author, of hydrated platinum monochlorid, $PtCl$, while hydrogen peroxid is left in the solution. The monochlorid dissolves in solution of sodium carbonate and acids, but is deposited apparently unchanged by subsequent dilution. Much interest will attach to further study of this salt, not only from its being the only representative of univalent platinum compounds, but also from its method of formation by direct dissociation. J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE United States Fish Commissioner, Mr. George M. Bowers, has appointed Professor H. C. Bumpus, Brown University, Scientific Director of the Wood's Holl Station. Professor Bumpus is Secretary of the Trustees of the Marine Biological Laboratory at Wood's Holl, and in the past has been very closely associated with the work done there. His recognized scientific attainments and executive ability, as well as his local knowledge of Wood's Holl and the vicinity, make this a most admirable appointment, full of promise for the prosecution of the scientific and economic work of the Fish Commission under the present administration.

THE daily papers have contained columns and pages on the alleged discovery, by Professor Samuel Schenk, of the University of Vienna, of a method of regulating the sex of children, and on the alleged discovery, by Dr. George Waltemath, of Hamburg, of a second moon for the earth. It may consequently be desirable to state that Professor Schenk has made no publication bearing on the production of sex, and that no scientific evidence has been offered for the existence of a second moon.

PROFESSOR W. A. ROGERS, died at Waterville, Me., on March 1st, aged sixty-one years. He was assistant professor of astronomy in the Observatory of Harvard University from 1875 until 1886, when he accepted a call to the professorship of physics and astronomy at Colby University. He had expected to enter on a professorship at Alfred University, N. Y., on April 1st. Professor Rogers was a member of the National Academy, and a past Vice-President for the American Association for the Advancement of Science. He made important contributions to astronomy and physics, especially to the technique of measurement, of which we hope to give some account in a future number of this JOURNAL.

MR. W. WHITAKER, F.R.S., has been elected President of the Geological Society, London, succeeding Dr. H. Hicks, F.R.S.

A TESTIMONIAL in recognition of the services of Mr. Francis H. Webb as Secretary of the Institution of Electrical Engineers, London, was presented to him on February 1st. The testimonial took the form of a cheque for over £600, together with a diamond brooch for Mrs. Webb, and an illuminated address to Mr. Webb, was read by Mr. Henry Edmunds, the secretary to the committee.

THE Paris Société de Geographie has awarded its gold medal to M. Sven Hedin for his explorations in Central Asia to which we have already called attention.

THE Society of Colonial Studies of Brussels has received a gift of $5,000 to promote the study of the diseases of the Congo, and offers two prizes of $500, one for some notable addition to our knowledge of the evolution of the hæmatozoon of Laveran within and without the body, and the other for the discovery of the origin of hæmoglobinuric fever.

A PRIZE of $3,000, named in honor of Galileo Ferraris, will be awarded at the approaching exhibition at Turin for the most valuable invention exhibited for the application of electricity to industrial purposes.

THE ninth Congress of French Alienists and Neurologists will be held this year at Angers on August 1st and following days. The questions proposed for discussion are: (1) Post-Operative Psychical Disturbances; (2) The Part played by Arteritis in the Pathology of the Nervous System; (3) Transient Delirium from the Medico-Legal Point of View.

ON the motion of M. Brouardel, the Paris Academy of Sciences has appointed a commission to study the question of the propagation of tuberculosis. The commission is to consist of the six members of the section of medicine and surgery, the two permanent secretaries and MM. Brouardel, de Freycinet, de Jonquières, Chauveau, Duclaux, Arm, Gautier.

THE British government has decided to appoint a Royal Commission to inquire into the bacterial treatment of sewage.

PROFESSOR J. A. FLEMING, F. R. S., has begun a course of five lectures at the Royal Institution, London, on 'Recent Researches in Magnetism and Diamagnetism.' Friday evening discourses have been given by Captain Abney, F. R. S., on 'The Theory of Color Vision applied to Modern Color Photography,' and by Professor T. E. Thorpe, F. R. S., on 'Some Recent Results of Physico-Chemical Inquiry.'

THE following lectures will be delivered at the Royal College of Physicians of London: the Goulstonian Lectures—Dr. John Rose Bradford, on March 15, 17 and 22; 'Observations on the Pathology of the Kidneys.' Lumleian Lectures — Sir Richard Douglas-Powell, on March 24, 29 and 31, on 'The Principles which govern Treatment in Diseases and Disorders of the Heart.' The Milroy Lectures, which should have been delivered by Dr. S. Monckton Copeman, on 'The Natural History of Vaccinia,' on March 3, 8 and 10, are unavoidably postponed, owing to the illness of the lecturer, to May 3, 5 and 10.

THE teachers of chemistry in the Somerville district, Massachusetts, met at the Malden High School on February 9th, and listened to the following papers: 'The Harvard Requisition in Chemistry,' Charles R. Allen; 'Home Work for Quantitative Pupils;' 'Chemical Theory,' B. F. Holden; 'Note Books,' Emerton Rice; and 'Reviews,' by Clarence Boylston.

THE Onondaga tribe of Indians, which is the Wampum Keeper of the Six Nations, has notified the Regents of the University of the State of New York that the University has been designated as the Wampum Keeper of the tribe and the Wampum belts will consequently be deposited in the State Museum.

THE Maryland Legislature has passed, by a vote of 65 to 20, the bill allowing the Trustees of the Sheppard Asylum to alter the name of the Institution to the Sheppard and Enoch Pratt Hospital in order that the institution may receive the one and-a-half million dollars bequeathed by the late Enoch Pratt.

THE Post-Office Department has ordered 25,000,000 postal cards of the standard library size intended for card indexes.

THE first meeting of the British Royal Com-

mission for the Paris Exposition of 1900 was held on February 18th, at Marlborough House. The Prince of Wales, the chairman, made an address, in the course of which he said that the exhibits will be divided into 18 groups, comprising 120 classes, in which provision will be made for the display of every kind of art, industry and manufacture. The guiding principle is that similar products, from whatever part of the world they may come, should be shown side by side, and in this respect the Exhibition of 1900 will differ from its predecessors, in which the products of each country have usually been collected together. The arrangement, though less favorable to a striking national display, has many advantages, and admits of a ready comparison of the arts and industries of one country with similar arts and industries of others. The Prince of Wales stated that in comparison with the appropriation of Germany, £250,000, and of Switzerland, £66,000, that of Great Britain was inadequate, and he hoped that the Treasury might be prevailed upon to increase it.

An international exhibition of products, of industry and aliments is to take place at Prague from the 15th to the 22d of May, this year. The exhibits will include all industrial products, food articles, eatables, and all kinds of beverages, hygienic and pharmaceutic products, general novelties, inventions and sporting accessories.

At its annual meeting, Feb. 2d, the Russian Geographical Society awarded, says *Nature*, a special Constantine medal to Dr. Nansen; a Constantine medal to V. I. Roborovsky, for his journeys in Central Asia; the Count Lütke's medal to I. I. Strelbitzky, for his journeys in Persia and Manchuria in 1891–96; the new Semenoff's medal to Dr. Sven Hedin, for his three years' journeys in Central Asia. A large gold medal of the Society was awarded to I. K. Zhdanoff, for his ethnological works, and especially for work on 'Russian Epical Poetry,' and small gold medals to Th. Witram, for pendulum measurements in the far East; to F. Sperck, for his large work on the climate of the Astrakhan region; to S. Rybakoff, for the collection of specimens of musical texts of songs amongst the Ural natives; and to S. Gulishambaroff, for his work 'The World's Trade in the Nineteenth Century and Russia's Part in it.' Silver medals were awarded to MM. Pastukhoff, for his ascension of the Elbrus; Abels, for hypsometrical measurements in the Urals; D. A. Fedchenko, for a communication on the Talas Alatau; Timonoff, for a paper on the water-communications on the tributaries of the Amur; Sapozhnikoff, for work on the glaciers of the Altai; Kovanoko and Semkovskiy, for the organization of international balloon ascensions in which the Society took a part; and to Prince Obolensky, Tomilovskiy and Utyesheff, for their daily observations upon the motions of the clouds.

The London correspondent of the New York *Evening Post* cables that the polar expedition upon which the Duke of the Abruzzi will start this summer will be both expensive and extensive. King Humbert contributes $100,000; the Duke devotes his whole income of $30,000 a year to the object, and, if necessary, also will draw upon his capital. After leaving Franz Josef Land, on foot or in sledges, the expedition will establish posts along the route. The Duke takes twenty experienced Italians, fifty Esquimaux and a number of dogs.

The German Antarctic Expedition Committee have decided to send an expedition to the South Polar regions under the direction of Dr. Erich von Drygalski.

Secretary Wilson, of the Agricultural Department, in pursuance of his determination as far as practicable to utilize the agricultural seed appropriation in securing 'new, rare and valuable' seeds, dispatched Professor Nilse E. Hansen, professor of horticulture at Brookings, S. D., to eastern Europe and Asia to secure new seeds and plants. Professor Hansen is now preparing his report for publication, after an extended trip through eastern Russia, Trans-Caucasia, Russian Turkestan, western China and Siberia. Many promising varieties were obtained, and about three car-loads of seed will be distributed to State experiment stations and others. These seeds, it is expected, will be chiefly of value in the arid regions, the purpose of Professor Hansen's trip being to ob-

tain such as were distinguished for resistance to drought and heat.

A MAP of Alaska, showing known gold-bearing rocks, with descriptive text containing sketches of the geography, geology and gold deposits and routes to the gold fields, has just been issued by the U. S. Geological Survey, in pursuance of a recent joint resolution of Congress. These pamphlets are to be had for the asking. There will be 40,000 copies in all. Most of them go to the Congressional document rooms, whence they will be distributed to the public on orders of Senators and Representatives; the remainder issue from the Survey office. The map, which is on a scale of 57 miles to the inch, is specially designed for the use of the miners, prospectors and travelers in Alaska. The region represented extends from Bering Strait eastward to the Rocky Mountains and British Columbia, and from the 54th parallel northward to the Arctic Ocean, embracing the drainage basin of the Yukon River from its mouth to its most distant headwaters. The principal topographic features, as plateaus, mountain regions and valleys, are indicated by hachures. More is known of the valleys and regions bordering the navigable drainage ways than of other portions of the country. Back from the rivers lie extensive rugged tracts still comparatively unexplored. The lines of magnetic variation are laid down. The Fort St. Michael Military Reservation, on the coast, is outlined. The center of this reservation is St. Michael Island, and it includes the great delta of the Yukon, the head of Norton Sound and Golofnin Bay. The map includes two smaller, local, larger-scale maps, one of the Fortymile and the Klondike gold-mining regions, the other of the mountainous area between the coast and the interior above Linn Canal, showing the passes, routes and trails leading from tide water to the headwaters of the Yukon. It is in part colored, showing at a glance by color and by name where gold and coal have been found, in both the interior and the coastal regions, especially the gold-bearing rock formations of the Fortymile and Birch Creek series. These gold-bearing rocks are seen to trend from the Klondike region for nearly 600 miles northwestward, across the great elbow of the Yukon, toward the coast. The descriptive text accompanying the map, consisting of 44 pages, contains useful information for the practical prospector and miner. It gives a brief historical, geographical and geological sketch of the country, describing its rivers, mountains, climatic conditions, routes, trails and passes, with valuable hints and directions to the traveler down the Yukon concerning the canyon and the dangerous White Horse Rapids. Besides the rock formations of the Fortymile and the Birch Creek series, the original deposits, or gold-bearing quartz veins, are broadly discussed and the probable extent of the gold deposits is indicated. Similar consideration is given to the detrital, or gold-bearing placer gravels, and to the mode of concentration of the coarse gold, its nature, and the manner of its extraction. Valuable metals other than gold, as platinum and copper, are also touched upon. The deposits of coal and lignite are mentioned somewhat fully. They occur mostly in the coastal regions and on the Lower Yukon, though good coal is also found in the Fortymile district, as on Coal Creek. Similar deposits have also been reported on the headwaters of the Stewart River, just above the Klondike.

IT is expected that the Dictionary of Philosophy edited by Professor J. Mark Baldwin, of Princeton University, and published by The Macmillan Company, will appear early in 1899. The staff of the Dictionary, as now organized, is as follows. Consulting Editors:

English: Professors H. Sidgwick, Andrew Seth and William James; *German:* Professors Windelband, Ziehen, Exner, Münsterberg; *French:* Professors Pierre Janet, L. Marillier, Th. Flournoy and Yves Delage.

Writers in charge of departments, as follows: *Philosophy:* Professors Josiah Royce, Andrew Seth and John Dewey; *Logic:* Professor Adamson; *Ethics:* Professors Sorley and James Seth; *Psychology:* Mr. Stout, Professors Cattell, Titchener and Baldwin; *Philology:* Professor Wheeler; *Physical Science and Mathematics:* Professors Simon Newcomb and H. B Fine; *Mental Pathology and Anthropology:* Professor Jastrow; *Biology:* Professors C. Lloyd Morgan and Minot; *Physiology:* Professor Hodge; *Economics:* Professor Hadley; *Political and Social Philosophy:* Professor Montague, Dr. James Bonar, Professor Giddings; *Jurisprudence and Law:* Judge S. E. Baldwin;

Philosophy of Religion: Professors A. T. Ormond and R. M. Wenley; *Education:* President De Garmo; *Æsthetics:* Professors Tufts and James Angell; *Neurology:* President C. L. Herrick, Dr. C. J. Herrick; *Bibliography:* Dr. Benj. Rand, Professor H. C. Warren; *Biography:* Professor G. A. Tawney; *Editor's Assistants:* Professor G. A. Tawney, Dr. W. M. Urban.

WE learn from *Cosmos* that the railway to the summit of the Jungfrau is being carried forward in spite of the cold weather. One of the mountain streams has been utilized, giving 2,400 h. p. which is used to drive by electric motors the drills excavating the tunnel, which has been carried a distance of eighty meters.

THE Bulletin of the Iron and Steel Association has made public the figures for the consumption of pig iron in the United States and its production since 1889 and including 1896, thus:

Years.	Actual production. Gross tons.	Estimated consumption. Gross tons.
1889	7,603,642	7,755,093
1890	9,202,703	8,943,338
1891	8,279,870	8,366,728
1892	9,157,000	9,303,315
1893	7,124,502	6,982,607
1894	6,657,388	6,694,478
1895	9,446,308	9,628,572
1896	8,623,127	8,275,774

It is a little too soon to estimate fully our consumption of pig iron in 1897, the import and export statistics of pig iron for the whole year not being as yet available, but a very close approximation to actual results is possible. We produced in that year 9,652,680 gross tons and imported say 18,000 tons. The imports in the first eleven months were 16,327 tons. At the beginning of the year there was on the market 847,686 tons of pig iron. The total supply for the year was, therefore, approximately, 10,518,366 tons. Of this total supply we exported about 260,000 tons. The actual exports in the first eleven months were 236,502 tons. There were on the market at the close of the year 874,978 tons. Deducting these two items from the total supply we have 9,383,388 tons as the approximate consumption of the year. This quantity is about 245,000 tons less than the consumption of 1895, and not very much in excess of the consumption of 1892. For the per capita consumption we have, as the 'index of civilization,' about 250 pounds per annum, which we think is unexcelled by the consumption of any other nation.

THE French Automobile Club will hold an international motor-car and carriage exhibition, in Paris, June 13th to July 3d, inclusive; and the regulations have just been issued. The exhibition is to be divided into the following seven sections: (1) motor cars and motor cycles, (2) motors, (3) tyres, (4) carriage work for motor-vehicles, (5) motor-car parts, fittings and accessories, (6) tools, etc., for motor-vehicle builders, (7) motor-car literature. Intending exhibitors may apply to Messrs. Thevin & Houry, Bureau de l'Exposition, 4 Place de l'Opera, Paris. Space is already announced to be limited and early application only can insure assignment.

THE Committee on Medical Expert Testimony, of the New York Academy of Medicine, has stated, in reporting progress, that it had been determined that improvement in the system of expert medical testimony must proceed along three lines, viz.: (1) the establishment of some standard of excellence for experts; (2) the appointment of the experts for given cases by the presiding judge, and (3) the fixing of the fees by the Court and the deposit of a certain portion of the sum in advance. It was recommended that those registering as experts before the Board of Regents should be required to specify the particular branch of medicine; that they should have been in practice ten years, and in the practice of their specialty for five years; that evidence of special study should be presented, together with a certificate of good moral character, and indorsements by the local county medical organization and a judge of a court of record.

WE learn from the *Lancet* that the annual meeting of the Royal Zoological Society of Ireland took place on January 25th, at the Royal College of Physicians, at Dublin. The report of the Council showed that the popularity of the the gardens, as a place of resort, was increasing, as proved by the rise in the gate receipts. In February, 1897, a deputation waited on Mr. Hanbury, at the Treasury, for the purpose of

pressing the claims of the Society to a grant, it being over ten years since the Science and Art Department had conferred on it the sum of £3,000, long since expended in the erection of buildings and in improvements in the gardens. In last March the Aquarium House was formally reopened by Her Excellency, the Countess Cadogan. The committee, headed by Dr. Samuel Gordon and Lord Powerscourt, having for its object the erection of a memorial building to bear the name of the former Honorable Secretary of the Society, the late Dr. Samuel Haughton, has received much public sympathy and support.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. JOSEPH F. LOUBAT has given to Columbia University property valued at $1,000,000, subject to a life annuity of $60,000. This great sum is for the support of the library, and is to be named the 'Gaillerd-Loubat Library Endowment Fund.'

THE bill has been presented in the Maryland House of Delegates appropriating $100,000 to the Johns Hopkins University. President Gilman has made a statement in which he explains how the income of the University has been decreased by the failure of the Baltimore & Ohio Railroad; in 1896–97 the income exclusive of the medical school and certain gifts given for special purposes was:

From investments	$50,796 44
Tuition	47,512 09
Relief fund of 1896	57,424 01
Rents	21,432 22
Total	$177,164 76

Expenses of the University were $191,156. The buildings, land and equipment of the University are valued at slightly over a $1,000,000.

THE Board of Trustees of Lafayette College have decided to rebuild Pardee Hall, the building containing the scientific departments, recently destroyed by fire, and to erect a chemical laboratory at a cost of $25,000. Towards the cost of this building $10,000 was subscribed at the meeting.

DR. E. D. PEARSONS, of Chicago, has donated $25,000 to Pomona College, Pomona, Cal., which will be used by the trustees for the erection of a new science building.

THE Jefferson Medical College, Philadelphia, has received, by the will of the late C. D. Shain, $7,000 for scholarships and prizes.

THE annual report of the Board of Regents of the University of the State of New York states that the colleges and professional and technical schools of the State in seven years have increased their expenditures from $2,733,860 to $5,771,325; the value of buildings and grounds, from $15,129,028 to $28,447,974; the libraries and apparatus, from $1,896,959 to $3,542,456, and the total property owned, from $39,045,604 to $77,148,944.

THE London University Commission Bill was introduced into the House of Lords by the Lord President of the Council on February 21st. It is identical with the bill of 1897, except that the names of the commissioners are not included.

THE Austrian government has compromised with the rioting university students by suspending the lectures for the balance of the semester, but permitting them to count the time as spent in residence. At the commencement of the summer semester on March 21st all students will be required to renew their pledge to observe the academic regulations.

PROFESSOR RUSSELL H. CHITTENDEN, without resigning his professorship in Yale University, has accepted the directorship of the department of physiological chemistry in Columbia University. Dr. W. J. Gies has been appointed instructor and Messrs. A. H. Redland and H. E. McDermott have been appointed assistants in the department.

PRESIDENT A. S. DRAPER, of the University of Illinois, has been offered the superintendentship of schools of New York City.

PROFESSOR LUIGI LOMBARDI has been appointed professor of technical physics at the Industrial Museum of Turin, in the room of the late Professor Galileo Ferraris.

DISCUSSION AND CORRESPONDENCE.

MUSCULAR DISTURBANCES IN MONOCULAR VISION.

IN a recent number of SCIENCE (February 25 1898) Mr. Charles H. Judd recounts some in-

teresting experiments on 'Binocular Factors in Monocular Vision.' This title is somewhat misleading. The essential characteristic of binocular vision consists in the simultaneous formation of slightly dissimilar images on the two retinas, with corresponding modification of the perception of depth in space. Mr. Judd's experiments relate to variation in direction of the two visual lines, with resulting production of double images; but fusion of these images is an indispensable requisite for the attainment of any binocular perception.

It is well known that most persons fail to perceive double images as phenomena attendant upon binocular vision. To perform binocular experiments the observer must have some training in the muscular control of the eyes, and also in visual perception. Such experiments occupied much of my attention some years ago (*American Journal of Science*, 1881–1883). In performing the first experiment described by Mr. Judd it is very easy to catch the heteronymous image, and by proper control of the eye to stop its motion instantly. The appearance of unrest of the object, to which he refers, is due to the motion of this image during the instant before fusion is attained. The visual line of the closed eye, as Mr. Judd correctly observes, does not converge toward that of the open eye. Since fusion of images is attained in natural binocular vision and without any conscious effort, on suddenly opening the unused eye, unconscious motion of both eyes results until fusion is secured. But the vision is strictly monocular until such fusion is completed, and the momentary illusion is not a binocular factor in such vision.

The experiment is perhaps most easily accomplished by covering one eye with the hand and suddenly removing this, instead of bringing the muscles of the eyelids into play. If the open eye be directed to some well illuminated object of known diameter and at a known distance, such as a clock dial, the angular displacement of the heteronymous image is easily found. It is only necessary to control the unused eye, resisting the tendency to secure fusion and noting the interval between corresponding edges of the two overlapping images. The ratio of this to the distance gives the angle.

The unused eye will in most cases be so directed that the two visual lines are approximately parallel. In cases of strabismus, external or internal, this parallelism is, of course, lost, but in such cases there is usually no power of binocular perception, one eye being habitually depended upon to the exclusion of the other.

When control of the eyes is lost temporarily through drowsiness the uncontrolled relation of the visual lines may be ascertained by winking one eye, if the observer is enough interested in binocular experiments to remember this, and to do this, in his semi-conscious condition. I have done so repeatedly, and have always found in my own case that the double images were homonymous; which indicates that the visual lines were crossed instead of divergent. I have watched the eyes of others under such conditions. In some cases the contraction of the rectus muscles was seen to be internal, in others external. No general rule on this subject can be formulated. It seems highly probable, however, that after consciousness becomes complete all the rectus muscles are completely relaxed, with more or less divergence of visual lines. By the aid of stereographs upon which the stereographic interval exceeds the observer's interocular distance, binocular vision by optic divergence is readily attained after a reasonable degree of muscular control of the eyes has been attained by practice. But for obvious reasons the external rectus muscles are comparatively but little under the control of the will, and 7° or 8° of such divergence is probably about a maximum for normal eyes.

I have elsewhere shown (*Am. Jour. Sci.*, May, 1882) that the ciliary muscle is also subject to the control of the will, though its action is most generally automatic. My observation accords with that of Mr. Judd that vision with a single eye is rarely if ever equal in distinctness to that with two eyes. But the accommodation of the single eye improves with time.

W. Le Conte Stevens.
Rensselaer Polytechnic Institute,
Troy, N. Y.

THE NORTHERN DURCHMUSTERUNG.

The Durchmusterung charts of the northern

sky are indispensable to every active astronomical observatory and to every astronomer who wishes to study the fainter stars. Unfortunately, the original edition of this work is exhausted, so that copies can no longer be supplied. A new edition is being prepared by the Bonn Observatory, and will be published shortly, provided that subscriptions for a hundred copies, at seventy Marks each, are promised before May 1, 1898. The price is very low, considering the amount of material furnished. After that date the price will be raised to one hundred and twenty Marks. The Astronomical Conference held at the dedication of the Yerkes Observatory appointed the undersigned a committee to aid this project. Orders for copies may be sent to the publishers, Messrs. A. Marcus and E. Weber, Bonn, Germany, or will be transmitted to them by any member of the committee. It is proposed to publish a list of American subscribers, and it is hoped that at least fifty copies will be taken by American astronomers. Since charts deteriorate rapidly by constant use several copies should be taken by each of the larger observatories. The members of the committee have shown their appreciation of the value of this work by ordering twelve copies for use in the institutions under their direction. It is of the greatest importance that the subscription list should be filled, as it is probable that in the future many similar enterprises may be undertaken, whose success will depend upon that now attained.

EDWARD C. PICKERING,
J. H. HAGEN, S. J.,
M. B. SNYDER,
Committee.

SCIENTIFIC LITERATURE.

Theoretical and Practical Graphics. By FREDERICK N. WILLSON, C.E., A.M., Professor in the School of Science, Princeton University. (Author's Edition.) 1897. 4to. Pp. viii + 264 + Appendix.

This is a most attractive work, not only conquering elementary graphics entire, but containing much more of highest geometric interest, including a fairly complete course on higher plane curves.

The part of the subject where Church so long held supremacy in America, with his Descriptive Geometry, justly appreciated for its elegance, is paralleled by Professor Willson in his chapter I. and chapters IX.–XII., 117 pages in all, including 219 figures in the text, where he not only covers with equal conciseness and elegance the matter of Church's 138 pages of text and 21 pages of illustration (102 figures), but in addition has treated many new and important matters, such as the Conoid of Pluecker (articles 333, 356, 477), a favorite surface of Sir Robert Ball, applied in his Theory of Screws, which itself may be looked upon as in part an application of non-Euclidean geometry, also the Cylindroid of Frézier (§§ 333, 360, 489), the corne de vache (§361, 475–6), and some special helicoids (§ 480–4), and also has covered the Third Angle (or 'shop') method of employing descriptive geometry, and given a very full treatment of development (§§ 405–20). The mathematical surfaces are beautifully illustrated.

The general plan of the book, while providing a comprehensive graphical training in the form of a progressive course, admits of specialization, of shorter courses, with noticeable flexibility. In fact, eight sub-groupings are indicated for independent courses. Comparison with the special treatises scrupulously cited shows the extent of matter on all topics usually treated to be surprisingly great. Professor Willson has a gift for condensing without loss of clearness.

With this power, he does well to restate for convenient reference many of the fundamental definitions which he presumes already in some form previously mastered—for example, the definition of the trigonometric functions on p. 31.

But I still prefer the definition in the note on p. 121, "A straight line is the line which is completely determined by two points:" to the author's second thought given in the preface, "The line that is completely determined by any two of its points." The spheric space of non-Euclidean geometry, though movable as a whole in itself, is such that two geodetic lines in it always cut in two points.

Of course, no spherical trigonometry is employed in the author's solution of the problems of trihedrals, purely a graphic process, as it should be. We are glad to find as an appendix

the author's brief but weighty paper on Trochoids which was presented before the American Association for the Advancement of Science a few years since. We cannot forbear to dwell upon the superb illustrations, which make the book a portfolio of art. The author is particularly happy in deciding conflicts of nomenclature, as where he refuses to follow Javary (§ 508) in calling the geodesic on a cone a conical helix.

The author has been extraordinarily painstaking in the proof-reading, and the book is practically free from error. A few trifles have been noticed: Page 156, § 433, first line, for 'prism' read 'cylinder.' Page 171, § 442, first line, for 'axes' read 'bases.' Page 37, sixth line from below, for 90° read 9°. Page 67, § 194, seventh line, for φ read θ.

The slip on page 55, § 166, in stating the brachistochrone and tautochrone properties of the cycloid, is so evidently a reference to a reversed or inverted line inadvertently omitted that it also is trivial. As the briefest hint of contents by chapters: I., definitions. II., freehand sketching. III., draughtsman's outfit. IV., use of instruments. V., higher plane curves. VI., conventional representations. VII., lettering. The treatment of lettering is particularly full and 64 alphabets are given. VIII., copying processes. IX., Descriptive Geometry of Monge. X., projections, intersections, development of surfaces, with applications to elbow joints, blast pipes, arch constructions, etc. XI., trihedrals. XII., projection of sphere. Here the now disused orthographic projection is somewhat condensed, but the stereographic, which is used, is treated at compensatory length. XIII., shades and shadows. XIV., perspective. XV. and XVI., isometric and clinographic projection, with applications; also crystals in oblique projection. XVII., bridge details, toothed gearing, etc. Out of a host of beautiful figures we may mention 92 as particularly efficient in teaching homology or *complete plane perspective.*

It is a particular pleasure to welcome the book, because it is on just the lines where English and American mathematics has hitherto been sterile.

Even now the tremendous, the fundamental importance of von Standt's geometry of position, the pure projective geometry, both for science and philosophy, is realized by few. For example, in the Bolyai type of non-Euclidean geometry, not only is the straight line infinite, but also it has two distinct points at infinity; it is never closed, even by points at infinity. Writing in 1835, even the superhuman penetration of Lobachévski attributed this essential openness to the straight in itself. In the introduction to his 'New Elements of Geometry,' he says: "I consider it unnecessary to analyze in detail other assumptions too artificial or arbitrary. Only one of them still deserves some attention, namely, the passing over of the circle into a straight line. Moreover, here the fault is visible from the beginning in the violation of continuity, when a curve which does not cease to be closed, however great it may be, must change immediately into the most infinite straight line, since in this way it loses an essential characteristic.

In this regard the imaginary geometry [the non-Euclidean geometry] fills out the interval much better. When in it we increase a circle all whose diameters come together at a point; finally we so attain to a line such that its normals continually approach, although they no longer can cut one another. This characteristic does not pertain to the straight, but to the curve which, in my paper 'On the Foundations of Geometry,' I have called *circle-limit.*"

Of course, it was not until in the next decade (1847) that von Standt published his immortal 'Geometrie der Lage,' but long afterward Helmholtz suffers still more seriously for lack of the pure projective geometry, treating the projective questions which necessarily came up in his extended optical researches, sometimes by means and methods of his own make, sometimes only by general reasonings.

Again, in *Mind* (1876) Helmholtz misses thus a fundamental difference. He says, p. 315: "It is, in fact, possible to imagine conditions for bodies apparently solid such that the measurements in Euclid's space become what they would be in spherical or pseudospherical space. * * * Think of the image of the world in a convex mirror. * * * Now Beltrami's representation of pseudospherical space in a sphere of Euclid's space is quite similar, except that the

background is not a plane as in the convex mirror, but the surface of a sphere, and that the proportion in which the images, as they approach the spherical surface contract, has a different mathematical expression."

But in reality these differences are so fundamental as to make all the difference between Euclidean and non-Euclidean; for the changed measure for distance in the mirror world is still Euclidean, parabolic, using an imaginary conic in the plane background as 'absolute' in Cayley's sense.

Thus Helmholtz reproduced the old but false theorem that in space of positive curvature two geodetic lines, if they in general cut, must necessarily cut in *two* points. He never attained the conception of single elliptic space, the type-form, but speaks only of 'spherical space of three dimensions.'

It is to be hoped that Professor Willson's book may hasten the day in America when courses in descriptive geometry and pure projective geometry, no longer confined to science schools, may be available in every college, and when there may be a more adequate realization of the power of spatial imaging as an instrument in scientific research.

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

Chapters on the Natural History of the United States. By R. W. SHUFELDT, M. D., etc. New York, Studer Bros. 1897. Pp. 480.

This volume is a collection of articles, most of which were published originally in 'Shooting and Fishing' and other periodicals, and now reappear, revised and somewhat expanded. A wide range of topics is covered—insects, crustaceans, fishes, amphibians, reptiles, birds and mammals occupy one or more chapters each, by far the larger space being given to birds. As a rule, each chapter treats some general subject, such as 'Crayfish and Crabs,' 'Gulls and their Allies,' 'The American Warblers and Sparrows,' passing the whole group in review, mentioning some of its more striking forms, and giving detailed descriptions of one or two species, with extended accounts of their habits, these latter often augmented by quotations of considerable length from various well-known authors. The anatomy of the animal under consideration is occasionally touched upon and questions of classification are frequently discussed—matters which, it may be feared, will not prove very interesting to the general reader, for whom the work is intended.

The book is illustrated with a hundred and thirty figures, many of them occupying full pages. Nearly one-half are reproductions of photographs of living animals, and are worthy of considerable study for the light they throw upon the possibilities and the difficulties in the use of photography for zoological illustration.

C. F. B.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 287TH MEETING, SATURDAY, FEBRUARY 26.

DR. E. A. DE SCHWEINITZ presented a paper on 'The Treatment of some Animal Diseases with Antitoxic Serums,' briefly reviewing the work as carried on in the Bureau of Animal Industry some years ago for the purpose of treating animals with the poisons formed by the swine plague and cholera suis germs. This work was fairly successful from an experimental standpoint, but did not seem to warrant practical use in the field on account of many difficulties which might arise. The preliminary experiments made in the Biochemic Laboratory with the serum of animals immune to cholera suis, in 1892, and again with those immune to cholera suis and swine plague germs, published in August, 1896, showed that these two diseases of swine which cause such enormous losses to the farmers of the country could be cured in experimental animals. Accordingly, practical field experiments were tried, which demonstrated that sick herds could be greatly benefited and a large portion of the animals cured if they were given injections of sufficiently strong serum that had been carefully prepared for the purpose of curing the two diseases above mentioned. The expense of this method if legitimately conducted is comparatively small, and it is possible to prepare a serum that would have the desired curative effect which should not cost more than 10 cents for each injected animal. Further practical experiments on a more extensive scale will be conducted, but the

results so far indicate that antitoxic serums, which have been of such inestimable value to the health of man in many diseases, may prove very valuable to the farmers.

Professor O. P. Hay spoke on 'The Protospondyli and Ætheospondyli of A. S. Woodward,' stating that the suborders of Mr. Woodward were not natural and that the families Semionotidæ and Pycnodontidæ should be removed from the group typified by *Amia* and placed among the families whose modern representative is *Lepisosteus*.

Dr. Theo. Gill spoke on 'The Classification of Astacoidean Crustaceans,' saying that the crayfish are of more than ordinary interest because since the appearance of Huxley's 'Introduction to the Study of Zoology' they have been largely used in laboratories for purposes of instruction. In connection with a university course, the speaker had occasion to investigate the group, and found differences of opinion among recent authors respecting various questions. Such are the limits of the superfamily, the limits of the families, the gradation of the families, or which is the most specialized, the origin of the different types, the nomenclature of the genera and of the families and superfamily. He had been led by his studies to results somewhat different from others in the aggregate, but agreed in almost all points with some one of the previous investigators. In his opinion the name *Astacoidea* of Dana may be retained as the name of a superfamily containing four families, which may be called *Eryonidæ*, *Homaridæ*, *Parastacidæ* and *Astacidæ*. Reasons for the adoption of the families, as well as for their sequence and nomenclature, were given. Special emphasis was placed on the development and degrees of approximation of the generative organs as indications of divergence and specialization.

F. A. Lucas,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON, FEBRUARY 23, 1898.

One of the communications was by Mr. H. W. Turner, U. S. Geological Survey, and was on the 'Origin of Yosemite Valley.'

The rocks surrounding the Yosemite Valley are chiefly granites and gneisses. These rocks, originally all massive, have been subjected to stresses resulting in the development of sets of partings, two of which are vertical, crossing each other at approximately right angles; another set horizontal, and two or more diagonal sets. At no place are all of these partings, which would be called by some a joint structure, equally developed. It is the rule that in the neighborhood of the valley a set of vertical partings running nearly parallel with the valley are most prominently developed. These are seen particularly well on a spur at the west end of the valley, at Cathedral Spires and at Sentinel Rock. What is probably another set extends up the spur east of the valley, passing just north of the Half Dome. At Yosemite Falls likewise a set of nearly vertical partings may be noted, although these are not readily seen from the valley below. Nearly all the topographic forms about the valley are dominated by these structure planes. To the vertical partings are due the vertical walls, and to the diagonal partings some of the inclined surfaces, like those of the Three Brothers. The domes of the valley are considered as due to exfoliation by weathering. Such exfoliation only takes place where a mass of the granite is not divided by joint structure. The vertical north face of the Half Dome is believed to be due to the vertical partings, the granite having broken off in slabs from time to time as the base was undermined by erosion, while the mass constituting the Half Dome, being comparatively free from partings, has become rounded by exfoliation of successive shells of weathered rock.

The Yosemite Valley is regarded as a widened portion of a river canyon, the upper portion of which is now occupied by Tenaya Creek. It is believed that river erosion had excavated a canyon here before the valley was occupied by a glacier. The small amount of débris in the valley along the base of the vertical cliffs is due to all the taleus having been removed by glacial ice. It should be remembered, however, that the exact form of the rock bottom of the valley is not known, inasmuch as the glacier, when retreating, left moraines at the west side of the valley which acted as a barrier, causing a temporary lake to form. The final result of this

was the deposit of a large amount of sediment, chiefly gravel and sand, which forms the present floor of the valley.

The other communication was on the Tertiary of South Dakota and Nebraska, by Mr. N. H. Darton, U. S. Geological Survey.

This communication, which was illustrated by lantern slides, set forth the results of recent stratigraphic studies covering Nebraska west of the 103d meridian and the adjacent area in the Big Bad Lands of South Dakota. Several great overlaps and unconformities were discovered which explain variations in fauna of the Neocene formations in different portions of the region. The White River series was found to be overlain southward in Pine Ridge and the Platte Valley by one, and in places two, formations which had hitherto not been differentiated. New light was obtained on relations of the Loup Fork beds of the northwestern Nebraska region to the Tertiary grit, etc., of the Kansas region. Account was given of the great sheets of volcanic ash interbedded at five horizons from the White River formation to early Pleistocene. The Dæmonelix beds were studied and much attention given to the underground water resources.

WM. F. MORSELL.

TORREY BOTANICAL CLUB, JANUARY 26, 1898.

THE first paper, 'New Sapindaceæ from South America,' was by Dr. Radlkofer, of Munich, and presented by Professor Burgess. It contained descriptions of *Urvillea*, *Serjania* and *Paullinia*, soon to be printed in the *Bulletin*. Their type specimens were exhibited, forming part of a collection made by Dr. Rusby in Bolivia.

The second paper, by Dr. J. K. Small, 'The genus *Bumelia* in the Southern States,' described the distinctive characters of 13 species, 5 of which had been before recognized. Discussion on specific limitation followed, President Brown, Dr. Britton, Dr. T. F. Allen, Dr. Small, Dr. Underwood, Professor Lloyd and the Secretary participating.

Dr. Britton spoke of cultivation in the Botanic Garden at Bronx Park as having already settled some questions of specific limits. Mr. Nash has, in this way, proved *Potentilla Canadensis* and *P. simplex* to be distinct, also the European *Pyrola rotundifolia* and the American species long so known.

The third paper was by Dr. N. L. Britton, 'Remarks on some species of *Senecio*,' with exhibition and discussion of illustrative specimens, and of several new species, soon to be printed. One species from White Sulphur Springs is one of three plants on Kate's Mountain, which find their nearest relatives on the Rockies, 1500 miles distant.

Discussion followed on the respective value to be assigned to different characters. Dr. Britton held that absence of rays is an uncertain distinction in *Senecio* and that involucral characters are more permanent. The Secretary remarked on the failure of achene characters in *Aster*, and Dr. Britton upon the same in *Helianthus*. Professor Lloyd remarking that *a priori* we should expect to find greatest variation in organs like leaves which are in direct contact with their environment, Dr. Britton said that though leaves vary much in form they vary but little in assimilation-tissues, their special character.

EDWARD S. BURGESS,
Secretary.

ENGELMANN BOTANICAL CLUB.

THE Club met at the Shaw School of Botany, February 10th, seventeen members present. Mr. Colton Russell read a paper on the topography and ecology of the Archean region of Missouri, and briefly described the different floral districts. He showed what an interesting field is here presented for the study of plants in relation to soil, humidity, exposure, etc. This region, sometimes picturesquely called the Missouri Island, is an ancient granitic outcrop in the southeastern part of the State, and contains rather extended sandstone areas. It is surrounded by a vast extent of limestone country. He exhibited specimens of rare and local plants, also specimens of rocks and soil. Five new members were elected.

The Club met again on February 24th, thirty-two members present. Mr. J. B. S. Norton read some biographical notes on the late Dr. J. F. Joor, whose herbarium recently became the property of the Missouri Botanical Garden.

Dr. Joor was an enthusiastic collector of Southern plants. Owing to ill-health he was rather reserved, but his zeal for his chosen pursuit knew no bounds. His collections were made chiefly about New Orleans, southern Louisiana and eastern Texas. Mr. H. von Schrenk exhibited some specimens of *Smilax bona-nox* covered with numerous hairs. These hairs seem to occur on this plant only in dry exposed places. He spoke briefly on the spines of *Xanthoxylum clavi-Hercules*, which at first grow on the epidermis of the stem, but are pushed out as the twig grows older by a layer of cork. A new cork layer is added each year, larger in area than the preceding one, so that at the end of a period of years the spine stands at the apex of a cork pyramid an inch or more in height. Mr. Walter Retzer spoke on some features of tricotyledonous plants, exhibiting seedlings of the following plants with three cotyledons: *Trifolium repens*, *Celosia cristata*, *Cosmos bipinnatus*, *Ilex Dahoon*, *Antirrhinum major*, *Verbena hybrida*, *Dianthus chinensis*. Four new members were elected.

HERMANN VON SCHRENK,
Secretary.

SCIENTIFIC JOURNALS.

THE *American Journal of Science* for March contains a short but important paper by Professor Michelson describing a spectroscope without prisms or gratings. With only twenty elements consisting of optical glass 5 mm. thick, the resolving power would be 100,000, which is about that of the best gratings. Professor Michelson has tried the experiment with seven elements and found that the Zeeman effect could be readily observed. The number contains a paper by Mr. N. H. Darton on 'Geothermal data from deep Artesian Wells of Dakota,' read at the recent meeting of the Geological Society of America, and an abstract, entitled 'Auriferous Conglomerate of the Transvaal,' by Mr. G. F. Becker of his paper published in the last report of the U. S. Geological Survey.

THE March number of *Appleton's Popular Science Monthly* contains as frontispiece a portrait of Lord Lister, which is accompanied by a sketch of his life and work. The important series of Lowell Institute lectures on the Racial Geography of Europe, by Dr. Wm. Z. Ripley, is completed in the present number with the 14th part entitled 'Urban Problems.' The first article is an illustrated account of 'The African Sahara by Professor Angelo Heilprin.' The number also contains an account of the St. Louis Academy of Natural Sciences, by Professor Frederick Starr, and several other articles of interest.

IN addition to the usual articles on Arctic exploration, birds and the Klondike, the popular magazines contain several contributions of interest to men of science. Under the title 'A National Seminary of Learning,' Dr. W J McGee reviews in *Harper's* the work of the scientific institutions and bureaus of Washington as realizing, to a great extent, Washington's wish for a great national university, and in the same journal Mr. H. S. Williams continues his series of articles on science, reviewing anatomy and physiology. The second of a series of articles in the *Cosmopolitan* on the choice of a profession is by Professor E. S. Holden, and reviews the opportunities offered by science to young men. In this connection may also be mentioned an article in the *Homiletic Review* on 'The Value of a Scientific Education for the Pulpit.'

THE *School Science Review*, a monthly journal 'devoted to science for the teachers in the common schools,' has begun publication at Granville, Ohio, succeeding *The Examiner*, of which two volumes had previously been published. The journal is edited by Mr. W. W. Stockberger, of the Doane Academy, Granville, assisted by Messrs. E. E. Richards and C. S. Hoskinson. Such journals indicate a growing interest in the study of science in the schools, and have a mission of increasing importance to perform.

HERR S. KARGER, Berlin, announces the publication, beginning with the present year, of a *Jahresbericht über die Leistungen und Fortschritte auf dem Gebeite der Neurologie und Psychiatrie*, edited by Drs. Mendel, Flatau and Jacobsohn, with the cooperation of a number of specialists.

A *Dermatologisches Centralblatt*, on the usual lines of German Centralblätter, has begun publication from the house of Veit & Comp. Leipzig. It is edited by Dr. Max Joseph, Berlin.